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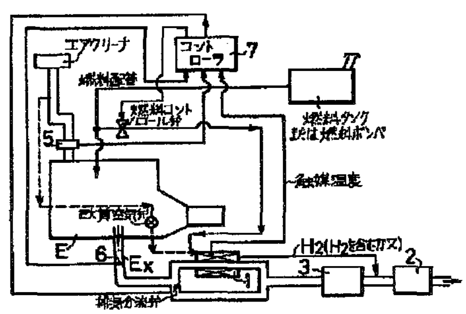
(54) NITROGEN OXIDE REDUCING DEVICE FOR INTERNAL COMBUSTION ENGINE

(57) Abstract:

PURPOSE: To deoxidize and purify the NOx in the exhaust gas directly by the H_2 from a hydrogen generator under the exhaust gas low temperature ambiance so as to reduce the NOx, by composing the system to make a part of a hydrocarbon fuel converted into a hydrogen gas to feed by a reformer catalyst converter.

CONSTITUTION: H_2 is fed near the entrance of a deoxidizer catalyst 2. The air amount is measured by a suction air amount sensor 5 of an engine E to make the H_2 to feed at the same level with the NOx in the exhaust gas. The NOx density in the exhaust gas is found by an NOx sensor 6, and after the NOx flow is calculated from the outputs of both sensors 5 and 6 in a controller 7, the fuel flow led in a reformer catalyst converter, and the reformer catalyst converter temperature by an exhaust gas flow dividing valve 11, and also an air valve 12 for reforming in the system to carry out a partial oxidization, are controlled in order to generate the H_2 corresponding to the NOx flow.



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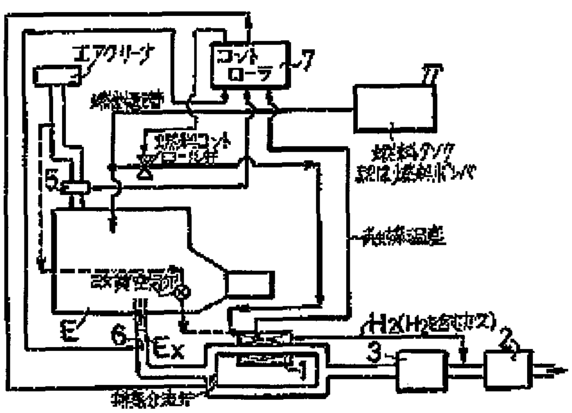
(54)【発明の名称】　内燃機関の窒素酸化物低減装置

(57)【要約】

【目的】　リーンバーンエンジンやディーゼルエンジン等において当該エンジンの燃費の良さを損なうことなく排気ガス中のO_2の濃度如何を問わずNO_xを有効に還元浄化し得る内燃機関のNO_x低減装置を提供する。

【構成】　内燃機関Eの燃焼室で供給燃料の燃焼による排気中にNO_xとO_2の存在のもと、排気系統Exに設けH_2とNO_xを接触反応しNO_xを浄化する触媒装置2の入口側に、メタノール又はLPG、天然ガス等の炭化水素燃料の一部を改質触媒コンバータによってH_2を生成する水素発生装置1からのH_2を供給し、排気系統の消音装置付近における排気低温雰囲気下で該H_2により前記排気中のNO_xを直接還元浄化して該NO_xを効率良く低減する。



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【特許請求の範囲】

【請求項１】　内燃機関の燃焼室で燃料供給装置より供給された燃料の燃焼による排気中に窒素酸化物と酸素ガスの存在のもと，排気系統内で水素ガスと窒素酸化物を触媒反応させ，窒素ガスと水に分解するための触媒装置を設けると共に，該触媒装置の入口側にメタノール又はＬＰＧ、天然ガスなどの炭化水素燃料の一部を改質触媒コンバータによって水素を生成する水素発生装置を設け，水素ガスを供給可能に構成し、排気系統の消音装置付近における排気低温雰囲気下で該水素発生装置からの水素ガスにより前記排気中の窒素酸化物を直接還元浄化して該窒素酸化物を低減するようにしたことを特徴とする内燃機関の窒素酸化物低減装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、内燃機関の窒素酸化物低減装置に係り，特に、希薄混合気を使用し、燃料消費向上をめざす，いわゆるリーンバーンエンジンやディーゼルエンジン，その他の水素エンジン等において，当該エンジンの燃費の良さを損なうことなく、排気中の酸素ガス（以下O_2 と称す）の濃度如何を問わず窒素酸化物（以下NO_x と称す）を有効に還元浄化しうるリーンNO_x 触媒排気浄化システムに関する。

【０００２】

【従来の技術】内燃機関，主としてピストン機関において排気の窒素酸化物（以下NO_x と称す）の低減方法には，従来，

① 三元触媒によるNO_x 低減法

② 超希薄空燃比の利用

③ リーンNO_x 触媒によるNO_x 低減法（例えば、特開平１－１３９１４５号公報）

の三つが考えられている。しかしながら、①の方法はエンジンに供給される燃料と空気の重量比が約１４．５、即ち理論空燃比でなければならない。もし理論空燃比より燃料が希薄な空燃比を使用するとNO_x は低減しない。しかるに燃料消費の経済性を考えると図２に示すように理論空燃比より希薄側でエンジンを運転した方が燃料消費率が少なく、効率が良いことが知られている。

【０００３】次に②はいわゆるリーンバーンエンジンによってNO_x 低減と燃費低減を両立させようとするものである。しかし，NO_x を十分低減できる空燃比を使おうとすれば、燃焼の失火限界に近づき，エンジンの燃費が悪くなるばかりでなく，運転が荒れ，ドライバビリティも悪くなる。これを防止するためシリンダ内の空気流れに乱れや流速増加を計り，燃焼速度を速くして失火限界をより希薄域になるように改良しようとするものがある。しかし、空気乱れや流速増加を過度に行うと，かえって着火時の火炎核形成や燃焼初期の火炎伝播が妨げられるため、この方法による失火限界の拡大には限界がある。また、シリンダ内の空燃比分布を調整して点火栓近傍のみ着火に適した濃混合気とする方法もあるが，図３に示すように失火限界がより希薄側に移ると、発生NO_x も破線で示したように，減少する割合が少なくなるので大きな効果は期待できない。

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【０００４】③は上記②の欠点を補うため、失火限界よりやや理論空燃比に近い燃料消費率最低点付近を使って運転し、やや低減不足のNO_x はゼオライト系リーンNO_x 触媒で浄化しようとするものである。この方法は燃費の良いシステムになる可能性がある。しかしながら、このリーンNO_x 触媒は，排気中に大量のO_2 存在下でNO_x を還元することになり、温度条件などが厳しく、現状では充分な触媒のNO_x 浄化率と耐久性が両立しにくいといった実用上解決すべき問題がある。以上のようにエンジンの燃料消費率を極力小さくできる空燃比を使いながらNO_x を充分低減する方法にはいずれも実用上の問題が多い。

【０００５】ところでリーンバーンエンジンでもディーゼルエンジンでも排気中に過剰O_2 を含むことは基本的に同じであるが，このエンジンの排気は、排気中にO_2 を含み、希薄混合気を使うほどO_2 濃度は大きくなる。このようなO_2 を含む排気中のNO_x 還元浄化を行う触媒をリーンNO_x 触媒といい、貴金属系、例えばゼオライト系の触媒が使われることが多い。このリーンNO_x 触媒では、NO_x 浄化率と温度との関係が図４に示すようになっている。そして，３５０℃以上の高温域は、主として$HC-NO_x$ の反応である。２５０～３５０℃以下の低温域は，NO_x のH_2 による還元反応となり、NO_x の浄化が可能である。

【０００６】しかし、リーンNO_x 触媒は、エンジンの排気マニホールド付近に設置されるので、排気温度が最高８００～９００℃にも達し、かつリーンバーンエンジンの排気は空燃比が理論空燃比より希薄側を使うので、排気中にH_2 は殆ど存在しない。従って、従来，低温側の特性は、利用不可能な領域であった。

【０００７】

【発明が解決しようとする課題】本発明の目的は，上記従来の種々の問題を解決するもので，リーンバーンエンジン又は常にO_2 （空気）過剰側で運転されるディーゼルエンジンの排気中にNO_x とO_2 の共存のもとでリーンバーンエンジンまたはディーゼルエンジンの燃費の良さを損なうことなく、排気中のO_2 の濃度如何を問わずNO_x を有効に還元浄化する排気浄化システムすなわち，NO_x の放出量を抑制し得る内燃機関のNO_x 低減装置を提供しようとするものである。

【０００８】

【課題を解決するための手段】本発明の内燃機関のNO_x 低減装置は，内燃機関の燃焼室で燃料供給装置より供給された燃料の燃焼による排気中にNO_x とO_2 の存在のもと，排気系統内でH_2 とNO_x を触媒反応させNO_x を浄化するための触媒装置を設けると共に、該触媒装

置の入口側にメタノール又はＬＰＧ．天然ガス等の炭化水素燃料の一部を改質触媒コンバータによって水素を発生する水素発生装置を設けてH_2を供給可能に構成し、排気系統の消音装置付近における排気低温雰囲気下で該水素発生装置からのH_2により前記排気中のNO_xを直接還元浄化して該NO_xを低減するようにした構成である。

【０００９】

【作用効果】上記構成からなる本発明の内燃機関のNO_x低減装置は．以下の作用を奏する。

【００１０】すなわち、本発明者等が案出した本発明の内燃機関のNO_x低減装置は、図１に示すような構成とすることによって、内燃機関の燃焼室で供給燃料の燃焼による排気中にNO_xとO_2の存在のもと、H_2とNO_xを接触反応させ、窒素ガスと水に分解する排気系統に設けた触媒装置の入口側にメタノール又はＬＰＧ．天然ガスなどの炭化水素燃料の一部を改質触媒コンバータに導きH_2を生成する水素発生装置からのH_2を供給し、排気系統の消音装置付近における排気低温雰囲気下で該H_2により前記排気中のNO_xを効率良く的確に直接還元浄化して該NO_xを低減する作用効果を奏する。このため．本発明の内燃機関のNO_x低減装置は、エンジンの使用空燃比が理論空燃比より過濃側．理論空燃比、理論空燃比より希薄側と排気中のO_2の存在又はO_2の濃度に関係なくNO_xを触媒によって低減できるのでエン＊

＊ジン（自動車）性能上、燃費上NO_x低減条件を考慮せずに最適値を選ぶことができる有利さを持たせ得る。

【００１１】

【実施例】実施例における水素発生装置はエンジンに使用する燃料によって改質触媒コンバータが次のように分類される。

【００１２】すなわち、メタノールを燃料とするエンジンにあっては

１）Ｐｄ、Ｐｔ．Ｃｕ／Ｃｒ／Ｎｉ等の遷移金属触媒を用い．メタノールを排気によって加熱蒸発させたガスを．この触媒に導きH_2を生成する。触媒入口ガス温度は３００℃程度が最良であって、この時の反応は

【００１３】

【化１】

$$CH_3OH \rightarrow CO + 2H_2$$

【００１４】となる。

【００１５】２）メタノール蒸気に空気を混合させ、Ｃｕ－Ｎｉ－Ｃｒ／アルミナ触媒によってメタノールの一部を部分酸化させ、H_2を生成する。温度は４００℃～５００℃が適当であり、メタノールに混入させる空気流量をコントロールし、温度を保つようにする。この場合の反応は、

【００１６】

【化２】

$$CH_3OH + Air \rightarrow H_2 + CO + H_2O$$

【００１７】となる。

【００１８】３）触媒にＣｕ－ＭｎまたはＣｕ－Ｚｎを用い．メタノールに水蒸気を加えるかまたは空気やメタノール水を加え水蒸気改質を行う。温度は２５０℃程度※

※が適当で、反応は

【００１９】

【化３】

$$CH_3OH + H_2O \rightarrow 3H_2 + CO_2$$

【００２０】となる。

【００２１】また、ＬＰＧ．天然ガスなどの炭化水素燃料を使うエンジンにあっては、触媒としてＮｉ．ＣＯ、Ｒｈを使い、温度３００～８００℃で改質する。この炭化水素燃料の場合には、水蒸気や空気や水タンクからの★

★水を加えて改質を行う。（触媒により温度が異なる。低温ではメタンが多く、高温ではＣＯが多い）。反応としては．

【００２２】

【化４】

$$HC + H_2O \rightarrow H_2 + CH_4 + CO_2 \quad 300\sim500℃$$

$$HC + H_2O \rightarrow H_2 + CO + CO_2 \quad 800℃$$

$$HC + Air \rightarrow H_2 + CO \quad 800℃$$

$$HC + 排気 \rightarrow H_2 + CO \quad 700℃$$

（ＥＧＲ改質）

【００２３】となる。

【００２４】また、本実施例の内燃機関のNO_x低減装置は．前記排気系統の排気管に装備するNO_xセンサ６と吸入空気量センサ５の出力からNO_x流量を算出し、常に適正なH_2量を決定し前記水素発生装置としての改質触媒コンバータを加熱するエンジン排気流量又は部分酸化を行う場合の空気量および改質燃料量を制御する構成とすることもできる。

【００２５】さらに、本実施例の内燃機関のNO_x低減装置は、当該内燃機関の回転数、吸気管負圧、吸気絞り弁開度又は燃料供給装置としての噴射ポンプの噴射量等の内燃機関における運転条件を検知できるセンサを具備

し当該センサの出力からNO_x流量を予測演算し前記水素発生装置の改質触媒コンバータに供給する燃料量をコントロールする学習制御方式にした構成とすることもできる。

【0026】しかも、本実施例の内燃機関のNO_x低減装置は、前記触媒装置の入口側においてH_2と排気の混合を均一にするため、ミキサーを具備したり、または、排気系統の消音装置を有効利用する構成とすることもできる。

【0027】詳述すれば、本実施例の内燃機関のNO_x低減装置は、前記従来の問題を解消するために案出されたものでその基本構成図を図1に示す。すなわち、本実施例の第1のポイントは、このH_2還元が排気低温側でエンジンEの全運転範囲において使用することである。第2のポイントは、低温側の利用を可能にするため構成システム中にH_2発生器1を組み込むことである。第3のポイントは、エンジンEの運転状態又は排気中のNO_x量によってH_2発生器1を制御し、常に排気中NO_xとモルで当量程度又は過剰のH_2が供給できるようにすることである。

【0028】還元触媒2は高温にさらされるとH_2がO_2と反応しH_2－NO_xの選択性が失われるので、350℃以上にさらされることのないよう消音器3の付近に配置する。そして、本実施例は、燃料配管から分岐し、流量コントロール弁を介してH_2発生器としての改質触媒コンバータに燃料を導入改質してH_2を発生させる。H_2は、還元触媒2の入口付近に供給する。供給するH_2は、排気中のNO_xとモルで当量程度にするためにエンジンEの吸入空気量センサ5によって空気量を測定し、排気中のNO_x濃度をNO_xセンサ6によってを求め、コントローラ7で両センサ5、6の出力からNO_x流量を演算した上で、NO_x流量に対応するH_2を発生させるため改質触媒コンバータに導入する燃料流量や、排気分流弁による改質触媒コンバータ温度、部分酸化を行うものでは改質用空気弁の制御を行う構成である。

【0029】図5において、横軸は、NO_xに対するH_2の供給比、縦軸は、NO_xの還元率（浄化率）を示す。NO_xに対して等量の（モル）H_2を供給すれば、もしNO_xとH_2が完全に混合するものとすればNO_xはすべて還元浄化される（理論値）。しかし実際には完全混合されないので還元率は実験値のようになる。理論より実験値の方が浄化率が良くなっている部分があるが、これは排気中の水蒸気が貴金属系触媒上で分解しH_2に変換していることによる。従って、供給したH_2より多くのH_2がNO_xと反応する。

【0030】その他の実施例としては、H_2による還元浄化を行うNO_x低減装置において改質触媒コンバータの入口側にH_2と排気とを混合ミキシングするミキサーを設置する機能とすることができる。また本実施例のその他のNO_x浄化装置である水素発生器および触媒装置は、それぞれ好適な作動温度範囲を持つため、内燃機関の排気系統において水素発生器を排気マニホールドの出口に設置した酸化触媒の後段に、また還元触媒は排気が膨張し温度が200℃以下に下がるマフラー内、あるいはその下流に設置することができる。

【0031】さらに、その他の実施例としては、水素発生器のH_2を供給してO_2共存下のエンジン排気中のNO_xを還元浄化するNO_x低減装置において、エンジンの排気マニホールド付近に酸化触媒、三元触媒、排気リアクタ等のHC、COを酸化する手段を持ち、かつリーンNO_x触媒としての改質触媒コンバータにPｔ－ゼオライト系触媒を用いる構成とすることができる。また、改質触媒コンバータに消音効果を持たせ改質触媒コンバータと排気マフラーを一体化構成とすることができる。

【0032】しかも、H_2によるNO_x還元を行うNO_x浄化装置において、ディーゼル機関用として改質触媒コンバータの上流にスートトラッパ、未燃焼生成物酸化手段を設置した構成とすることができる。また、本実施例において、内燃機関はガソリンエンジン、ディーゼルエンジンの他、水素エンジンでも良く、これらのNO_x低減装置に有効に適用し得る。この水素エンジンの場合は、水素発生装置が必要でなく、燃料としてのH_2をコントローラを介してバイパス的に供給することにより適用することができる。

【0033】

【第1実施例】エンジン排気量11のリーンバーンエンジンに本発明のシステムを適用する第1実施例を図6に示す。第1実施例のエンジンE_1は、アイドル時の空気過剰率λ＝0．95～1．0（理論空燃比よりやや過濃側か理論空燃比）各回転数の全負荷時および急激加速時はλ＝0．8～1．0（過濃側）、これ以外の運転条件はλ＝1．2～1．8の希薄側で運転するエンジンE_1である。従って、排気中のO_2は、0～10％程度まで変化する。排気系統E_xは、排気マニホールド8の出口に酸化触媒9を設置し、HC、CO等の不完全燃焼生成物を酸化し浄化する構成である。さらに、消音器としてのマフラー13の下流側に還元触媒12を配置する。還元触媒12の入口にはH_2と排気との混合を均一化するためミキサー10が設けられている。

【0034】H_2発生器11は、図7、図8に示すように改質触媒14を用いた水電解H_2発生器である。

【0035】水素発生器11は分岐された排気管内にコイル状のインナーコアを形成し、インナーコアの一端にはメタノールを噴射する電磁燃料噴射弁が設けてあり、他端はミキサーに導かれている。インナーコアの入口付近はメタノールを蒸発させるための多孔セラミックが充填してあり、その後にはペレット状の改質触媒が詰まっている。（モノリス状の触媒を使うときはインナーコアをコイル状から直線状に変更する。）触媒はPdを使っている。図6中、15はエンジンE_1への空気量を測定

する吸入空気量センサで、16は排気中のNO_x濃度を測定するNO_xセンサである。

【0036】本第1実施例の場合、NO_xとモルで当量のH_2を必要とするので、エンジンE_1の排気中のNO_x濃度にもよるが、50km／hの車速のとき0．3l／minのH_2，最大出力最大馬力時では1．0l／min程度のH_2を必要とする。このH_2は燃料の一部を改質して供給されるものであるが、それぞれの運転条件下における消費H_2が走行燃費に及ぼす影響は1～2％以下であり、リーンバーンエンジンを使う燃費低減メリット15～20％に比べれば無視できる程度であり、リーンバーンエンジンの低燃費特性を損なうことがない。

【0037】また、H_2発生に要するメタノールは、50km／h走行で0．15l／min（蒸気）程度である。

【0038】以上のように本第1実施例は、少量の燃料をH_2発生器11において改質して還元触媒12の低温側特性を利用して、H_2－NO_x還元を行うので、エンジンE_1の運転空気過剰率λに無関係にNO_xの低減が計れる実用上有意義なリーンバーンNO_x低減システムである。また、H_2と共に副生するCOはシフト反応

【0039】

【化5】

$$CO + H_2O \rightarrow H_2 + CO_2$$

【0040】でH_2に変換するか、またはPd膜によりH_2とCOとに分離し、高純度なH_2として還元触媒12の前方に供給する方法もある。しかし、副生するCOは微量であり、そのまま還元剤として還元触媒12の中で働くことができ、COを放出することはない。

【0041】

【第2実施例】第2実施例は、空調用、発電用等に使うガスエンジンの場合である。燃料は天然ガスの場合を示す。このような目的の定置用エンジンは自動車用と異なり、一定回転数、一定負荷で運転される。従って、改質触媒コンバータの温度は一定に保ち易い。第2実施例の構成は図9に示すように前記第1実施例とほぼ同一であるので、同一部分は同一符合を付して説明を省略する。

【0042】水素発生器に供給する燃料は第1実施例と異なり、天然ガスであり、空気と混合して供給する必要なH_2を確保するため、空気、天然ガスとも調整弁によってコントロールする。コントロールは、前記第1実施例とほぼ同じ様で、前記第1実施例とほぼ同様の作用効果を奏する。

【0043】

【第3実施例】前記各実施例において、燃料の一部を改質してH_2を発生させる装置とゼオライト系触媒を組合せ、NO_xを還元浄化するエンジンのNO_x低減装置は、H_2の供給条件、内容によってNO_x低減性能に大きな差異を生じることが分かってきた。図10に示すように、NO_x，O_2を含むエンジンの排気を触媒に流し、改質触媒コンバータの上流からH_2を供給した場合のNO_x浄化率を図11に示す。図11において横軸はNO_xに対するH_2の供給割合を示し、1．0は、NO_xとH_2が当量の場合である。縦軸は還元によってNO_xが浄化される割合であって、1．0はNO_xがすべて浄化されてしまうことを示す。

【0044】図10に示す改質触媒コンバータ60内に、図12に示すペレットタイプの触媒61が入っている場合は図14から分かるように高い浄化率を示す。図13に示したモノリスタイプの触媒62にすると、同じH_2供給量であっても浄化率は低下する。

【0045】図12に示したペレットタイプの触媒61は、入口でH_2と排気ガスとが十分混合せず、H_2に濃度分布があっても迷路のようなペレットの隙間をガスが直進して行く過程で十分混合し、H_2と排気ガスが均一化される。

【0046】一方、図13に示したモノリスタイプの触媒62は、断面"蜂の巣"状の孔をが多数有しており、一個の孔はガス流れの方向に独立しているので、入口でH_2に分布があれば途中で互いに隣り合う流路内のガスが混合しにくい。実際の実験によれば、排気管の太さは車載上の制約から大幅に太くすることは困難でガス流速は速く、H_2は中央部付近に高濃度領域を作り、モノリス周辺部にはH_2がほとんど供給されない不都合を生じている。従って、モノリスタイプは、H_2の利用率がペレットタイプに比べ低い。

【0047】一方、エンジン排気システムとして見ると、ペレットタイプは振動によってペレットが互いに擦れ合って粉末化し易いこと、ガスの直進断面積が小さく、通過抵抗が大きく、排圧増大を招き、エンジン性能自身を悪化する欠点がある。従って、触媒にはモノリスタイプを使うことが望ましいが、この場合にはH_2の供給に工夫が必要になる。

【0048】そこで、第3実施例は、モノリスタイプの触媒を使いペレットタイプより優れたNO_x浄化率を得るようH_2の供給を均一混合する構成上簡素な装置から成る。すなわち、混合装置69としてのH_2噴出ノズル63の基本的構造を図14，図15に示す。挿入されたH_2噴出ノズル63は、中空円筒形状で、排気の流れ方向にL字状に曲がっており、放射状に複数の噴出孔64を有する。放射状の噴出孔64は、4～6個が適当で、1列又は複数列設けられている。（図14では噴出孔が3列配設されている）。

【0049】噴出ノズル63の挿入管外径dと排気管65の内径Dとはdが Dの20％以上必要で、dを大きくすると流路の抵抗が大きくなるので図16に示すように排気管65の一部を断面拡大形成する。又、噴出ノズル63から改質触媒コンバータ60までの距離LはDの少なくとも2倍以上を必要とし、10倍以上大きくしても改善効果は少ない。混合装置は、上述の他に、構成を図

17，図18に示すようにすることができる。すなわち，H_2 を撹拌させる部分は、小径のH_2 噴出ノズル66とこれより大径で壁部に複数の噴出孔67を設けた有底筒68とから成るほぼ2重管状に構成されている。噴出したH_2 は，まず，H_2 噴出ノズル66に排圧の動圧によって流入する排気と混合し、有底筒68の内筒から外筒に噴出し，内外筒の間を流れる排気により更に混合する。このように2段階の混合過程を経るのでほぼH_2 と排気が完全に均一混合することができる。

【0050】内外筒の大きさ（直径，または断面積）は混合に大きく影響し、内筒が小さいとほとんどの排気は外筒を流れ、十分動圧を利用できない。図17，図18に於いて内外筒の直径比はD／d（外筒／内筒）は3～1．7程度が有効で2付近が最良である。

【0051】上記構成からなる第3実施例は、混合が良好となり、モノリスタイプであってもペレットタイプ同様の浄化率を得ることができる。同一浄化率において供給H_2 量を30～60％節約することができるので、H_2発生に要する燃料を少なくでき，エンジンの出力や燃費への影響を軽減できる。

【0052】例えば，1．6lのリーンバーンガソリンエンジンにおいて通常の運転域代表点で評価すると，エンジン回転数2000rpm，トルク40Nm．この時のNO_x 放出量0．44l／min．このNO_x をH_2 還元で浄化するのに要するH_2 流量は，0．66l／min。0．66l／minのH_2 を発生させるのにH_2 発生器への燃料は0．33l／minの燃料蒸気になる（メタノールの場合）。

【0053】D／d＝2である図17，図18に示す装置によって混合促進を行えば，H_2 の供給量はNO_x と等量の0．44l／min程度で済み，燃料は0．22l／minの蒸気0．22l／minの蒸気に低下する。即ち0．11l／minの節約となる。

【0054】

【第4実施例】前記実施例においてゼオライト系触媒を用い，水素発生器によって水素を発生させ、H_2 をゼオライト系触媒の入口に供給しH_2によるNO_x 還元を行えば排気中に高濃度のO_2 が存在していても大きなNO_x 浄化率が得られる。

【0055】しかし、従来のNO_x 触媒、例えば三元触媒，Cu－ゼオライト系触媒に比べると低温の反応であって，従来の触媒がSV値（通過ガス流量l／hrと触媒体積lの比）50，000～100，000を使っているのに比べると反応速度の関係からより小さなSV（例えば10，000～60，000）を使わなくてはならない。このシステムを車載する場合、本システムの改質触媒コンバータは入口ガス温度から排気系統の下流，例えば排気マフラー付近になる。しかるに車輌に於いては車輌構造上SV値の大きい（コンバータの大きさの大きい）改質触媒コンバータを設置する場所になっており，すべての車輌へは適用し難い。

【0056】本第4実施例は，改質触媒コンバータの設置を容易にするため、リーンNO_x 触媒をマフラーに内蔵させコンパクト化を計るためのマフラー構造およびマフラーに触媒を内蔵させても温度条件からNO_x 浄化を可能とするものである。

【0057】すなわち、第4実施例の構成は，図20，図21に示すように，排気マフラー80にリーンNO_x 触媒82を内蔵させるとNO_x コンバータと，排気マフラーを直列に配置することなく片方で済むため，配置スペース的に極めて有利となる。図20，図21に排気マフラー80にモノリス触媒82（Pt－ゼオライト系）を内蔵した消音効果を持たせた改質触媒コンバータ83を示す。

【0058】改質触媒コンバータ83の上流よりH_2 を混入混合された排気が矢印方向より流入し，ミキシングプレート84に衝突し，このミキシングプレート84の大小複数の流通孔85を通過して排気とH_2 が十分混合しながらモノリス触媒82に流入する。ミキシングプレート84には排気流速最大になる中心部に流通孔85が設けられていないので，H_2 がモノリス中心部に集中することはない。ミキシングプレート84の流通孔85は，大小それぞれ直径を異にして複数配列されているので通過流速が異なり，ガスの攪拌が起こると共に干渉によって消音効果を奏する。

【0059】ところで，排気マフラーはエンジン排気系統の最後尾に配置されるのが一般的で，排気マフラーの入口ガス温度は途中で冷却されるので低くなる。入口温度が最も高いエンジンの最高回転数最大馬力時でも150～200℃であり，通常使用頻度の高い運転条件では100～150℃程度である。

【0060】従来の三元触媒やCu－ゼオライト系のリーンNO_x 触媒では300～400℃以上でないと十分な反応が期待できないからマフラー内に触媒を内蔵させることはできない。前記実施例において，H_2 による還元を行えば低温で浄化できることを示したが，温度は150～300℃程度であって排気マフラーの入口温度と比べればやや高い温度範囲にある。

【0061】本発明者等は，O_2 共存下でH_2 を供給するNO_x 低減触媒の活性について触媒成分として何を選定するべきかを種々実験的に検討した。その結果，Pd，Rhは活性が全くなく，Cuは活性が悪く，Ptが高い活性を示すことを見出した。ただし，Ptは高分散である必要があり，そのためには高比表面積（少なくとも100m^2 ／g以上）を有するアルミナ、シリカ、ゼオライト等の担体が必要である。

【0062】更に、本発明者等は，NO_x 低減のリーンNO_x 触媒およびH_2 混合以前に行うべき前処理について種々に検討を行った。その結果を図19に示す。エンジンの排気にH_2 を混合してNO_x 低減のリーンNO_x

触媒（Ｐｔ系）に導くと図１９中、曲線Ｂに示すように活性の最高点は２５０℃付近にある。

【００６３】アフターバーナ、リアクタ、三元触媒、酸化触媒等をエンジンマニホールド付近に設け、ＣＯ、ＨＣを酸化し予め低減除去した後にH_2を供給しNO_x低減の改質触媒コンバータに導くと図１９中曲線Ａに示すように活性温度が低温側にシフトし，１００～１５０℃で高い活性を示すことを新たに見出した。

【００６４】この温度は，排気マフラーの入口温度と一致し，排気マフラー８０内にＰｔ－ゼオライト系の還元触媒８０を内蔵することにより初めて可能ならしめた。更に，ＨＣ、ＣＯを除去した後にリーンNO_x触媒によるNO_x浄化を行った方が浄化率も改善でき、ＨＣ－O_2の不完全な反応から触媒上にススを形成することもない実用上優れた作用効果を奏する。

【００６５】更にモノリス触媒８２の後に干渉チューブＥｘ１を設置することにより消音効果をより良好にしている。図２２は図２０、図２１と同様の作用効果を奏するもので、ミキサー部の形態を前記ミキシングプレートと異にし、中空筒状部材であるミキシングパイプ８６とした点が異なる。上記構成からなる第４実施例は，改質触媒コンバータ８３と排気マフラー８０が一体化構成とすることができるので、コンパクトとなり車載性が良好となる実用的効果を奏すると共に、全運転範囲で高いNO_x浄化率を維持できる優れた効果を奏する。

【図面の簡単な説明】

【図１】本発明の実施例の基本構成を示す構成図

【図２】空燃比と燃料経済性の関係を示す線図

【図３】リーンバーンエンジンの燃費とNO_xの関係を示す線図

【図４】リーンNO_x触媒の特性を示す線図

【図５】H_2供給率とNO_x浄化率の関係を示す線図

【図６】本発明の第１実施例装置の概要を示す構成図

【図７】第１実施例装置におけるH_2発生器の断面図

【図８】第１実施例装置におけるその他のH_2発生器の要部を拡大して示す構成図 ＊

＊【図９】本発明の第２実施例装置の概要を示す構成図

【図１０】本発明の第３実施例装置の概要を示す構成図

【図１１】第３実施例装置に関してNO_x浄化率の関係を示す線図

【図１２】第３実施例装置に関してペレットタイプの触媒構成を示す概要図

【図１３】第３実施例装置に関してモノリスタイプの触媒構成を示す概要図

【図１４】本発明の第３実施例装置の概要を示す縦断面図

【図１５】本発明の第３実施例装置の概要を示す横断面図

【図１６】本発明の第３実施例装置の概要を示す概要図

【図１７】本発明の第３実施例装置のその他の例を示す縦断面図

【図１８】本発明の第３実施例装置のその他の例を示す横断面図

【図１９】本発明の第４実施例に関してNO_x浄化率状況を示す線図

【図２０】本発明の第４実施例装置の概要を示す縦断面図

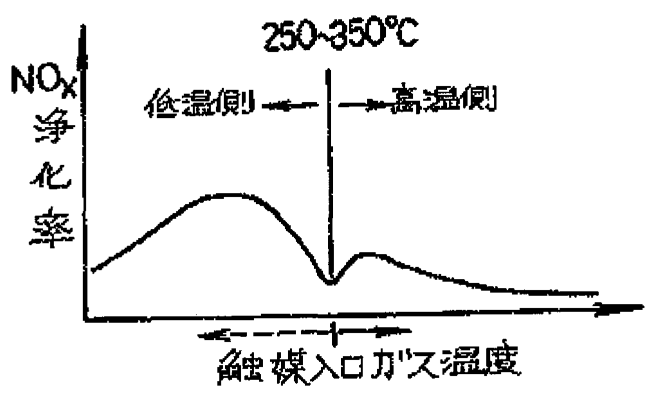
【図２１】本発明の第４実施例装置の概要を示す横断面図

【図２２】本発明の第４実施例装置のその他の構成を示す縦断面図

【符号の説明】

Ｅ．E_1	エンジン
１．１１	H_2発生器
３．１３、８０	消音器
１２．６０	還元触媒
９	酸化触媒
５	吸入空気量センサ
６	NO_xセンサ
７	コントロール電源
１０	ミキサー

【図4】



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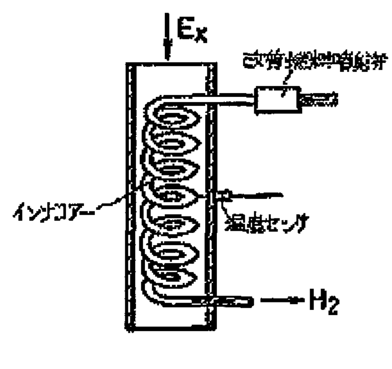

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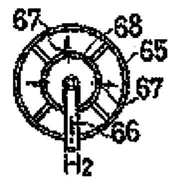

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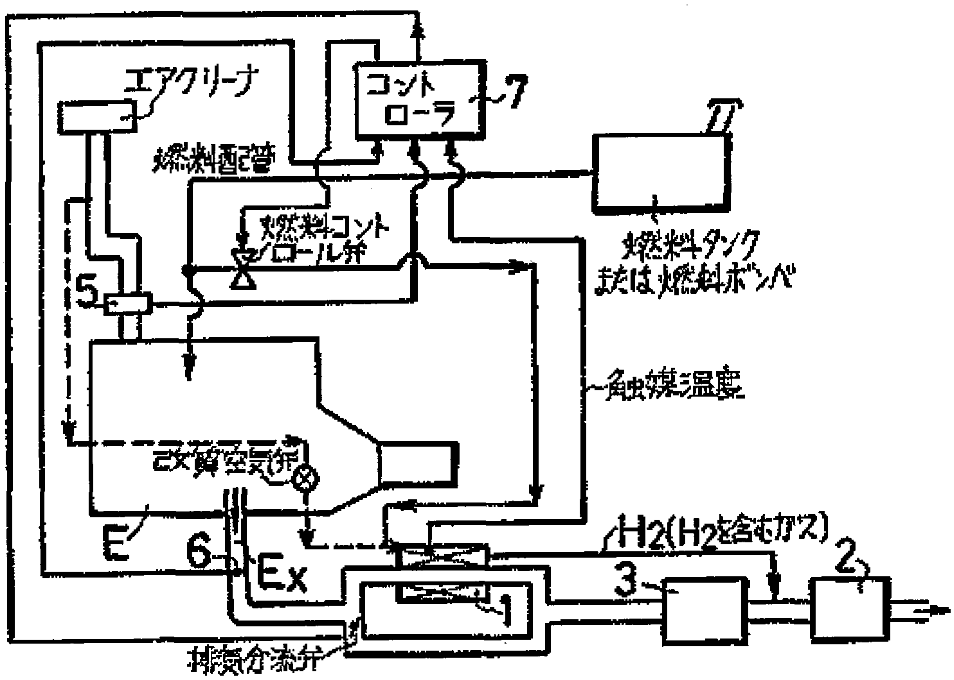
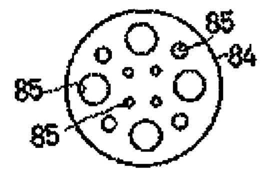


【図15】

【図21】



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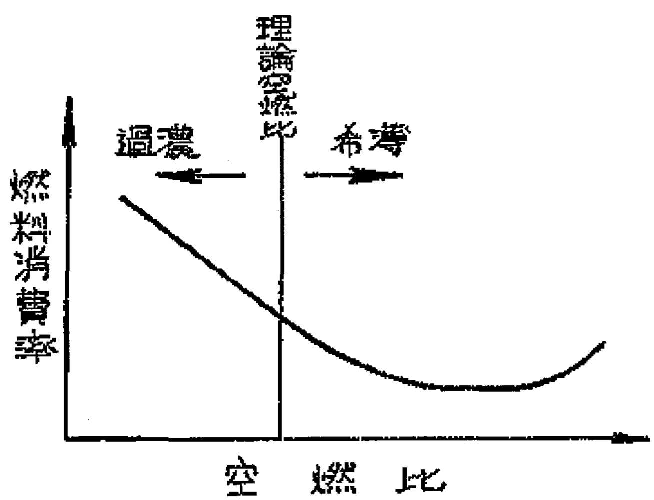

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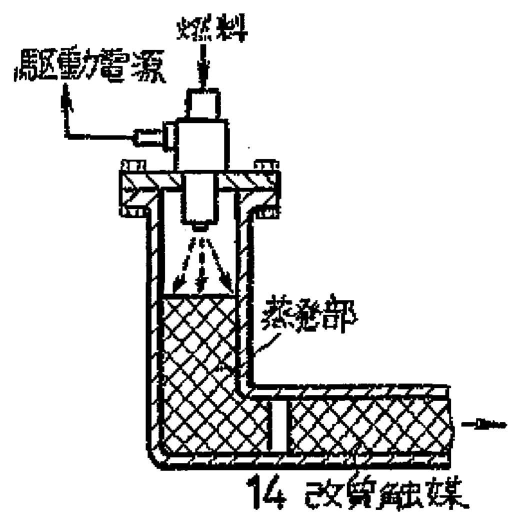

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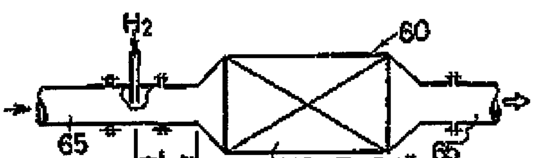

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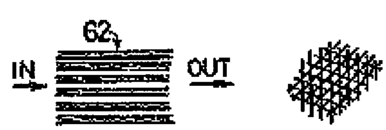
【図13】



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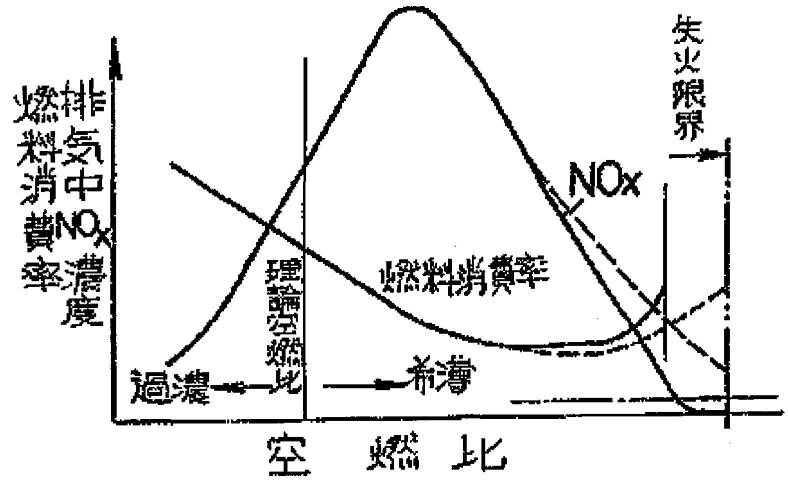

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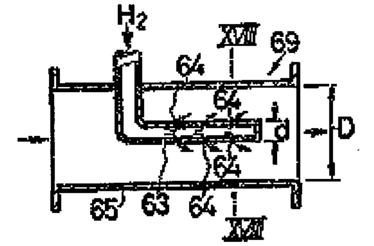

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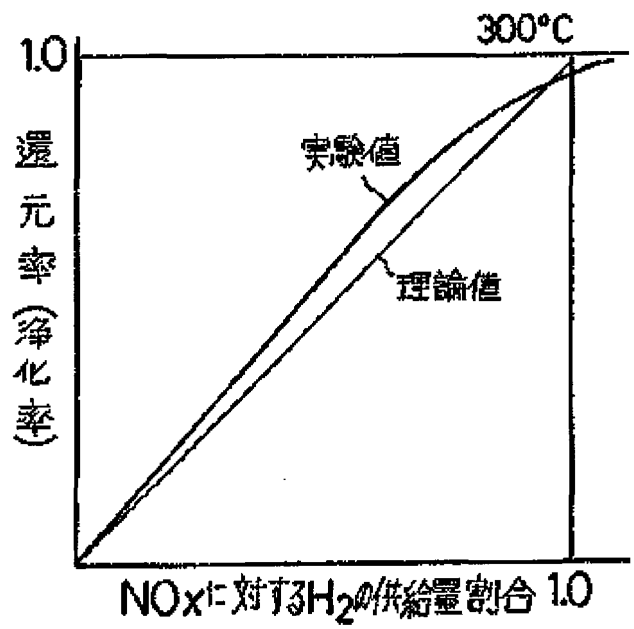

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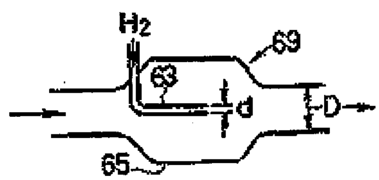

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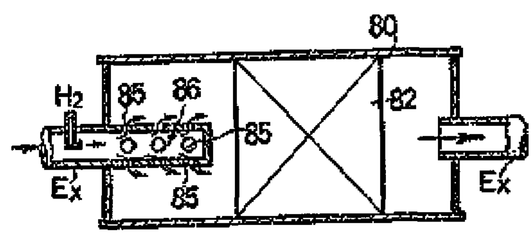

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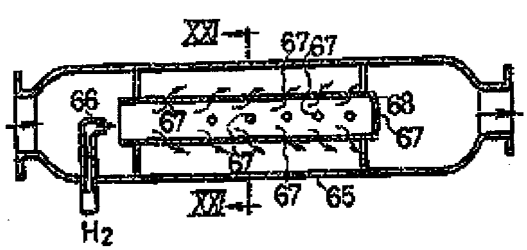

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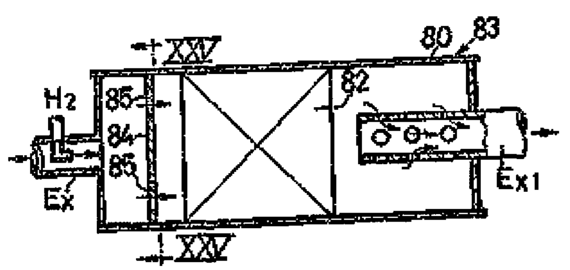

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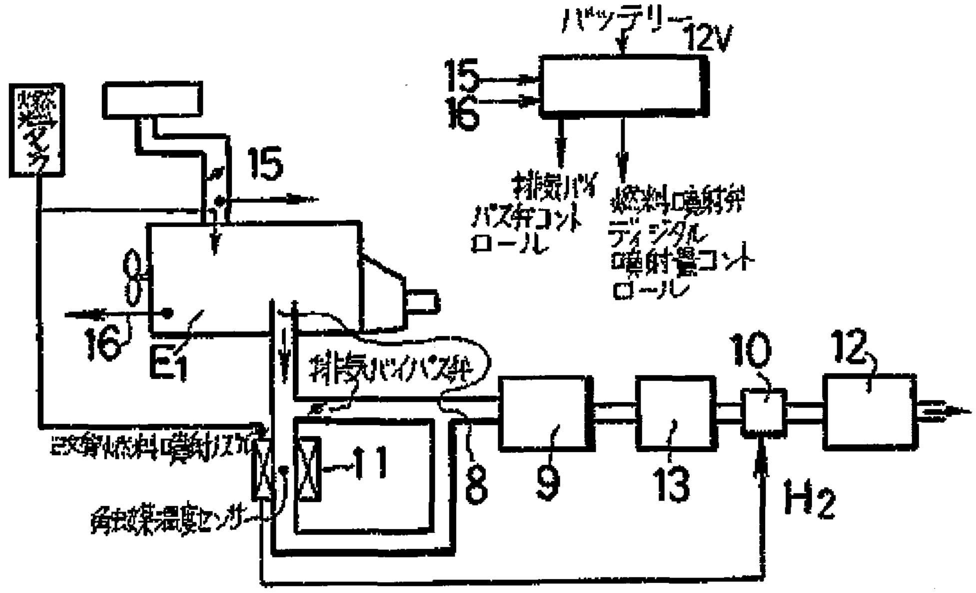
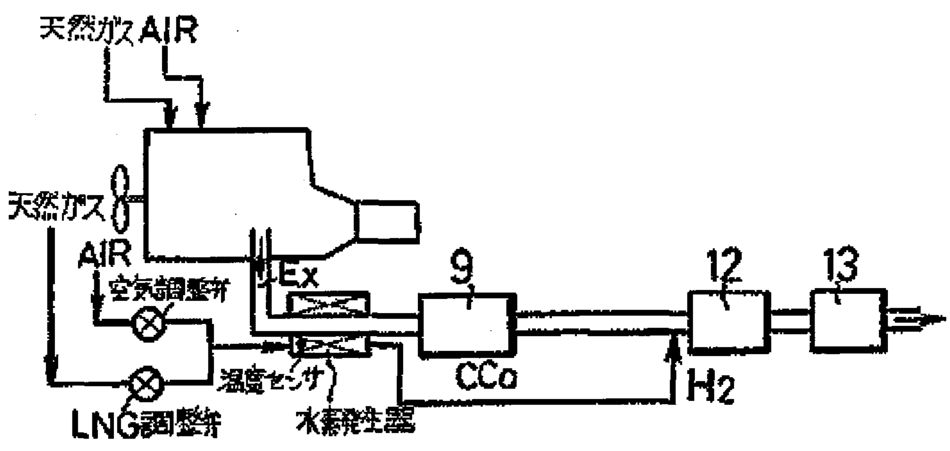
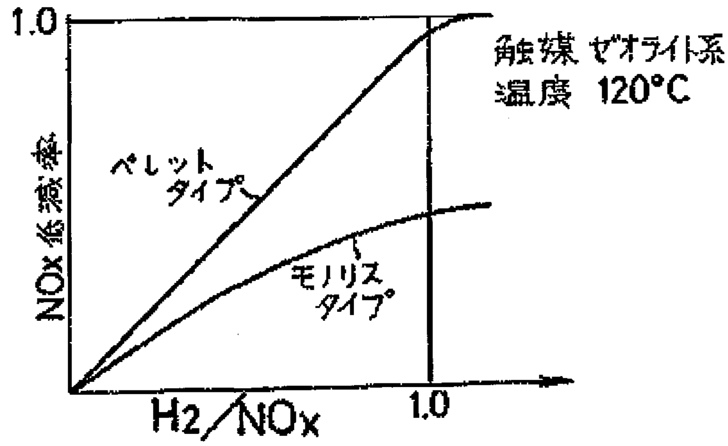

バッテリー
12V
15
16
15
16
排気バイパス弁コントロール
燃料噴射弁
ディジタル
噴射量コントロール
排気バイパス弁
E1
改質燃料噴射ノズル
触媒温度センサー
11
8
9
13
10
12
H2

【図9】


天然ガス
AIR
天然ガス
AIR
空気調整弁
LNG調整弁
Ex
温度センサ
水素発生器
9
CCo
12
13
H2

【図11】



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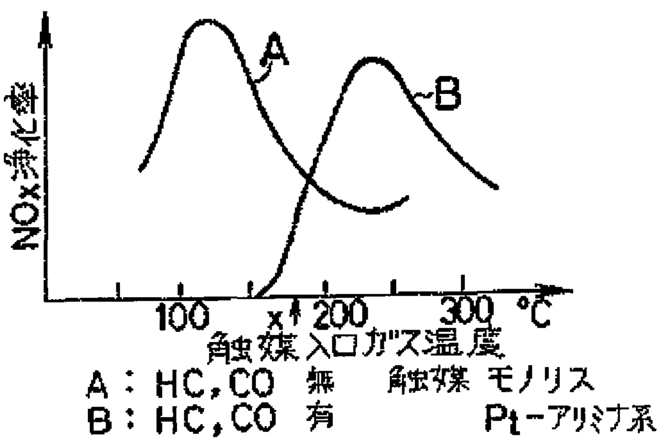

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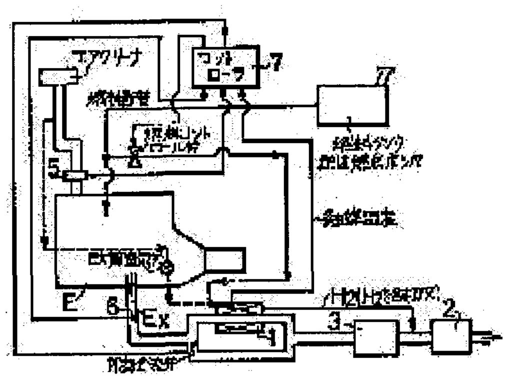
(54) NITROGEN OXIDE REDUCING DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PURPOSE: To deoxidize and purify the NOx in the exhaust gas directly by the H2 from a hydrogen generator under the exhaust gas low temperature ambiance so as to reduce the NOx, by composing the system to make a part of a hydrocarbon fuel converted into a hydrogen gas to feed by a reformer catalyst converter.

CONSTITUTION: H2 is fed near the entrance of a deoxidizer catalyst 2. The air amount is measured by a suction air amount sensor 5 of an engine E to make the H2 to feed at the same level with the NOx in the exhaust gas. The NOx density in the exhaust gas is found by an NOx sensor 6, and after the NOx flow is calculated from the outputs of both sensors 5 and 6 in a controller 7, the fuel flow led in a reformer catalyst converter, and the reformer catalyst converter temperature by an exhaust gas flow dividing valve 11, and also an air valve 12 for reforming in the system to carry out a partial oxidization, are controlled in order to generate the H2 corresponding to the NOx flow.



CLAIMS

[Claim(s)]

[Claim 1]Both that it is characterized by comprising the following to an entrance side of this catalyst device Methanol or LPG, A hydrogen generator which generates hydrogen by a reforming catalyst converter for some hydrocarbon fuel, such as natural gas, is provided, A nitrogen-oxides reduction device of an internal-combustion engine constituting hydrogen gas so that supply is possible, carrying out direct reduction purification of the nitrogen oxides under said exhaust air with hydrogen gas from this hydrogen generator under an exhaust air low temperature atmosphere in near the silencer of an exhaust system, and reducing these nitrogen oxides.

A basis of existence of nitrogen oxides and oxygen gas during exhaust air by combustion of fuel supplied from a fuel supply system in a combustion chamber of an internal-combustion engine.

A catalyst device for carrying out catalytic reaction of hydrogen gas and the nitrogen oxides inside, and decomposing into nitrogen gas and water.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]In what is called the lean burn engine and the diesel power plant, other hydrogen fueled engines, etc. which this invention requires for the nitrogen-oxides reduction device of an internal-combustion engine, and use a lean mixture and aim at the improvement in fuel consumption especially, without it spoils the goodness of the fuel consumption of the engine concerned -- the concentration of the oxygen gas (O_2 is called below) under exhaust air -- it is related with the Lean NO_X catalyst exhaust gas cleaning system which can carry out reduction purifying of the nitrogen oxides (NO_X is called below) effectively regardless of how.
[0002]
[Description of the Prior Art]In a piston engine, as an internal-combustion engine and the Lord, to the reducing method of the nitrogen oxides (NO_X is called below) of exhaust air. The NO_X decreasing method by the use ** Lean NO_X catalyst of the NO_X decreasing method ** super-rarefaction air-fuel ratio by the former and ** three way component catalyst (for example, JP,1-139145,A)
Three ** are considered. However, the weight ratio of the fuel in which the method of ** is supplied to an engine, and air must be about 14.5, i.e., theoretical air fuel ratio. If fuel uses a thin air-fuel ratio from theoretical air fuel ratio, NO_X does not decrease. However, it is known that considering the economical efficiency of fuel consumption specific fuel consumption has few directions which operated the engine by the thin side from theoretical air fuel ratio as shown in drawing 2, and it is efficient.
[0003]Next, ** tends to reconcile NO_X reduction and fuel consumption reduction with what is called a lean burn engine. However, if it tries to use the air-fuel ratio which can reduce NO_X enough, it approaches the misfire limit of combustion, and engine fuel consumption not only worsens, but it will be ruined and drivability will worsen. In order to prevent this, disorder and the increase in the rate of flow are measured with the air flow in a cylinder, the rate of combustion is made quick and there are some which are going to improve a misfire limit so that it may become a thin region more. However, since the flame kernel formation at the time of ignition and the flame propagation in early stages of combustion will be barred on the contrary if air disorder and the increase in the rate of flow are performed too much, there is a limit in expansion of the misfire limit by this method. Although there is also the method of making it into the rich mixture which

adjusted the air-fuel ratio distribution in a cylinder and to which only the neighborhood of an ignition plug was suitable for ignition, since the decreasing rate will decrease as the dashed line also showed generating NO_X if a misfire limit spreads to a thin side more as shown in drawing 3, a big effect is not expectable.

[0004]** In order to compensate the fault of the above-mentioned **, it is going to operate using near [slightly near theoretical air fuel ratio] a specific-fuel-consumption minimum score from a misfire limit, and NO_X in which reduction is a little insufficient tends to purify with a zeolite system Lean NO_X catalyst. This method may become a fuel-efficient system. However, there is a problem which should be solved practically that NO_X purifying rate and endurance of catalyst this Lean NO_X catalyst will return NO_X under a lot of O_2 existence during exhaust air, severe [a catalyst] temperature conditions etc. and sufficient under the present circumstances can be easily incompatible. The method of reducing NO_X enough all has many practical problems, using the air-fuel ratio which can make engine specific fuel consumption small as much as possible as mentioned above.

[0005]By the way, although it is fundamentally the same that excess O_2 is included during exhaust air also by the lean burn engine or a diesel power plant, O_2 concentration becomes large, so that exhaust air of this engine uses a lean mixture including O_2 during exhaust air. The catalyst which performs NO_X reduction purifying under exhaust air containing such O_2 is called Lean NO_X catalyst, and the catalyst of a precious-metals system, for example, a zeolite system, is used in many cases. In this Lean NO_X catalyst, the relation between NO_X purifying rate and temperature shows drawing 4. And a not less than 350 ** pyrosphere is mainly a reaction of HC-NO_X. A low temperature region 250-350 ** or less serves as a reduction reaction by H_2 of NO_X, and purification of NO_X is possible for it.

[0006]However, since an exhaust-gas temperature amounts also to a maximum of 800-900 ** since a Lean NO_X catalyst is installed near an engine exhaust manifold, and an air-fuel ratio uses a thin side from theoretical air fuel ratio in exhaust air of a lean burn engine, H_2 hardly exists during exhaust air. Therefore, the characteristic by the side of low temperature was a field which cannot be used conventionally.

[0007]

[Problem(s) to be Solved by the Invention]The purpose of this invention is what solves the above-mentioned conventional various problems, Without spoiling the goodness of the fuel consumption of a lean burn engine or a diesel power plant under coexistence of NO_X and O_2 during exhaust air of a lean burn engine or the diesel power plant always operated by the Oover$_2$ (air) side, the concentration of O_2 under exhaust air -- it is going to provide NO_X reduction device of the exhaust gas cleaning system, i.e., the internal-combustion engine which can control the burst size of NO_X, which carries out reduction purifying of the NO_X effectively regardless of how.

[0008]

[Means for Solving the Problem]NO_X reduction device of an internal-combustion engine of this invention, A basis of existence of NO_X and O_2 during exhaust air by combustion of fuel supplied from a fuel supply

system in a combustion chamber of an internal-combustion engine, Form a catalyst device for carrying out catalytic reaction of H_2 and the NO_X within an exhaust system, and purifying NO_X, and. Provide a hydrogen generator which generates hydrogen by a reforming catalyst converter for some hydrocarbon fuel, such as methanol or LPG, and natural gas, in an entrance side of this catalyst device, and H_2 is constituted so that supply is possible, It is the composition of carrying out direct reduction purification of the NO_X under said exhaust air by H_2 from this hydrogen generator under an exhaust air low temperature atmosphere in near the silencer of an exhaust system, and having reduced this NO_X.

[0009]

[Function and Effect]NO_X reduction device of the internal-combustion engine of this invention which consists of the above-mentioned composition does the following operations so.

[0010]Namely, NO_X reduction device of the internal-combustion engine of this invention which this invention person etc. invented, The basis of the existence of NO_X and O_2 during exhaust air according to combustion of supply fuel in the combustion chamber of an internal-combustion engine by having composition as shown in drawing 1, Carry out the catalytic reaction of H_2 and the NO_X, and to the entrance side of nitrogen gas and the catalyst device formed in the exhaust system decomposed into water Methanol or LPG, H_2 from the hydrogen generator which leads some hydrocarbon fuel, such as natural gas, to a reforming catalyst converter, and generates H_2 is supplied, The operation effect which carries out direct reduction purification of the NO_X under said exhaust air exactly efficiently by this H_2 under the exhaust air low temperature atmosphere in near the silencer of an exhaust system, and reduces this NO_X is done so. For this reason, NO_X reduction device of the internal-combustion engine of this invention, Since an engine operating air-fuel ratio can reduce NO_X according to a catalyst regardless of the concentration of existence of O_2 a thin side and under exhaust air, or O_2 from a rich side, theoretical air fuel ratio, and theoretical air fuel ratio, from theoretical air fuel ratio On engine (car) performance, The profitableness which can choose an optimum value without taking into consideration fuel consumption top NO_X reduction conditions can be given.

[0011]

[Example]A reforming catalyst converter is classified according to the fuel which uses the hydrogen generator in an example for an engine as follows.

[0012]That is, if it is in the engine which uses methanol as fuel, the gas which carried out heating evaporation of the methanol by exhaust air is led to this catalyst using transition metal catalysts, such as 1Pd, Pt, and Cu/Cr/nickel, and H_2 is generated. About 300 ** is best and catalyst inlet gas temperature is a reaction at this time. [0013]

[Formula 1]

$$CH_3OH \rightarrow CO + 2H_2$$

[0014]It becomes.

[0015]2) Make methanol vapour mix air, according to Cu-nickel-Cr/alumina catalyst, carry out partial

oxidation of some methanol, and generate H_2. 400 ** - 500 ** are suitable for temperature, it controls the air flow rate made to mix in methanol, and maintains temperature. The reaction in this case, [0016]

[Formula 2]

$$CH_3OH + Air \rightarrow H_2 + CO + H_2O$$

[0017]It becomes.

[0018]3) Cu-Mn or Cu-Zn is used for a catalyst, and add a steam to methanol, or add air and methanol water, and perform steam reforming. About 250 ** is suitable and temperature is a reaction. [0019]

[Formula 3]

$$CH_3OH + H_2O \rightarrow 3H_2 + CO_2$$

[0020]It becomes.

[0021]If it is in the engine using hydrocarbon fuel, such as LPG and natural gas, nickel, CO, and Rh are used as a catalyst and it reforms at the temperature of 300-800 **. In the case of this hydrocarbon fuel, the water from a steam, air, or a water tank is added, and refining is carried out to it. (Temperature changes with catalysts.) There is much methane at low temperature and there is much CO at an elevated temperature. As a reaction, [0022]

[Formula 4]

$$HC + H_2O \rightarrow H_2 + CH_4 + CO_2 \quad 300\sim500℃$$

$$HC + H_2O \rightarrow H_2 + CO + CO_2 \quad 800℃$$

$$HC + Air \rightarrow H_2 + CO \quad 800℃$$

$$HC + 排気 \rightarrow H_2 + CO \quad 700℃$$

（ＥＧＲ改質）

[0023]It becomes.

[0024]NO_X reduction device of the internal-combustion engine of this example, NO_X flow is computed from the output of the NO_X sensor 6 with which the exhaust pipe of said exhaust system is equipped, and the suction-air-quantity sensor 5, It can also have composition which controls the air content and the amount of reforming fuel in the case of performing the engine exhaust gas flow or partial oxidation which determines the always proper amount of H_2 and heats the reforming catalyst converter as said hydrogen generator.

[0025]NO_X reduction device of the internal-combustion engine of this example, The number of rotations of the internal-combustion engine concerned, intake pipe negative pressure, As an intake throttle valve opening or a fuel supply system. It can also have composition made into the learning control method which controls the fuel quantity which possesses the sensor which can detect the operating condition in internal-combustion engines, such as injection quantity of ************, carries out prediction arithmetic of the NO_X flow from the output of the sensor concerned, and is supplied to the reforming catalyst converter of said hydrogen generator.

[0026]And since NO_X reduction device of the internal-combustion engine of this example makes mixing of

H_2 and exhaust air uniform in the entrance side of said catalyst device, it can possess a mixer or can also consider it as the composition which uses the silencer of an exhaust system effectively.

[0027]If it explains in full detail, NO_X reduction device of the internal-combustion engine of this example was invented in order to solve said conventional problem, and shows drawing 1 the basic constitution figure. That is, the 1st point of this example is that this H_2 reduction uses it in the whole drive range of the engine E by the exhaust air low temperature side. The 2nd point is incorporating the H_2 generator 1 into a constitution system in order to enable use by the side of low temperature. The 3rd point is controlling the H_2 generator 1 by the operational status of the engine E, or the amount of NO_X under exhaust air, and enabling it to always supply an equivalent grade or superfluous H_2 by NO_X and a mol during exhaust air.

[0028]Since H_2 will react to O_2 and the selectivity of H_2-NO_X will be lost if exposed to an elevated temperature, the reduction catalyst 2 is arranged near the silencer 3 so that it may not be exposed to not less than 350 **. And this example branches from fuel piping, carries out introductory reforming of the fuel via a flow control valve at the reforming catalyst converter as an H_2 generator, and generates H_2. H_2 is supplied near the entrance of the reduction catalyst 2. In order to make H_2 to supply into an equivalent grade by NO_X and the mol under exhaust air, an air content is measured by the suction-air-quantity sensor 5 of the engine E, boil NO_X concentration under exhaust air NO_X sensor 6, after asking for **** and calculating NO_X flow from the output of both the sensors 5 and 6 by the controller 7, It is the composition which controls the air valve for refining by the fuel flow introduced into a reforming catalyst converter in order to generate H_2 corresponding to NO_X flow, and the thing which performs reforming catalyst converter temperature by an exhaust air flow dividing valve, and partial oxidation.

[0029]In drawing 5, the delivery late of H_2 [as opposed to NO_X in a horizontal axis] and a vertical axis show the reduction rate (purifying rate) of NO_X. If equivalent weight of H(mol) $_2$ is supplied to NO_X, and NO_X and H_2 shall be mixed thoroughly, reduction purifying of all the NO_X will be carried out (theoretical value). However, since complete mixing is not carried out actually, a reduction rate becomes like an experimental value. Although there is a portion to which the purifying rate is good from theory in the experimental value, it is because the steam under exhaust air decomposed on the precious-metals system catalyst and has changed this into H_2. Therefore, many H_2 reacts to NO_X from supplied H_2.

[0030]In NO_X reduction device which performs reduction purifying by H_2 as other examples, it can be considered as the function to install the mixer which carries out mixed mixing of H_2 and exhaust air in the entrance side of a reforming catalyst converter. The hydrogen generator and catalyst device which are NO_X purges of others of this example, Since it has a respectively suitable operating temperature range, a reduction catalyst can be installed in the inside of the muffler to which exhaust air expands and temperature falls at 200 ** or less, or its lower stream again in the latter part of the oxidation catalyst which installed the hydrogen generator in the exit of an exhaust manifold in the exhaust system of an internal-combustion engine.

[0031]In NO_X reduction device which supplies H_2 of a hydrogen generator and carries out reduction purifying of the NO_X under engine exhaust gas under O_2 coexistence as other examples, It can have composition which has a means to oxidize HC, such as an oxidation catalyst, a three way component catalyst, and an exhaust air reactor, and CO near an engine exhaust manifold, and uses Pt-zeolitic catalyst for the reforming catalyst converter as a Lean NO_X catalyst. A sound deadening effect can be given to a reforming catalyst converter, and a reforming catalyst converter and an exhaust air muffler can be considered as unification composition.
[0032]And in NO_X purge which performs NO_X reduction by H_2, it can have composition which installed the soot trapper and the unburnt glow output oxidizing means upstream of the reforming catalyst converter as an object for diesel engines. In this example, a hydrogen fueled engine besides a gasoline engine and a diesel power plant may be sufficient as an internal-combustion engine, and it can be applied effective in these NO_X reduction devices. In the case of this hydrogen fueled engine, a hydrogen generator is not required, and it can be applied by supplying H_2 as fuel in bypass via a controller.

[0033]

[The 1st example] The 1st example that applies the system of this invention to the lean burn engine of the engine displacement 11 is shown in drawing 6. Engine E_1 of the 1st example at the time of the excess air factor lambda= 0.95 at the time of idling - the full load of 1.0 (they are rich side or theoretical air fuel ratio a little than theoretical air fuel ratio) each number of rotations, and rapid acceleration lambda= 0.8-1.0 (rich side), Operating conditions other than this are engine E_1 operated by a thin lambda= 1.2-1.8 side. Therefore, O_2 under exhaust air changes to about 0 to 10%. Exhaust-system E_x is composition which installs the oxidation catalyst 9 in the exit of the exhaust manifold 8, oxidizes and purifies incomplete combustion output, such as HC and CO. The reduction catalyst 12 is arranged to the downstream of the muffler 13 as a silencer. In order to equalize mixing with H_2 and exhaust air in the entrance of the reduction catalyst 12, the mixer 10 is formed in it.
[0034]The H_2 generator 11 is a water electrolysis H_2 generator using the reforming catalyst 14, as shown in drawing 7 and drawing 8.
[0035]The hydrogen generator 11 forms the coiled inner core in the branched exhaust pipe, the electromagnetism fuel injection valve which injects methanol is provided in one end of the inner core, and the other end is led to the mixer. It is filled up with porous ceramics for near the entrance of the inner core to evaporate methanol, and the reforming catalyst of the pellet type is got blocked in after that. (When using a monolith-like catalyst, the inner core is changed into linear shape from a coiled form.) The catalyst is using Pd. 15 are a suction-air-quantity sensor which measures the air content to engine E_1 among drawing 6, and 16 is a NO_X sensor which measures NO_X concentration under exhaust air.
[0036]Since H_2 of the equivalent is needed by NO_X and a mol in the case of the 1st example, are based also on NO_X concentration under exhaust air of engine E_1, but. In the time of H_2 of 0.3 l/min, and the maximum output maximum horsepower, H_2 of about 1.0 l/min is needed at the time of the vehicle speed of

50 km/h. Although this H_2 reforms some fuel and it is supplied, The influence which consumption H_2 under each operating condition has on run fuel consumption is 1 to 2% or less, is a grade which can be disregarded if compared with 15 to 20% of the fuel consumption reduction merit using a lean burn engine, and does not spoil the low-fuel-consumption characteristic of a lean burn engine.
[0037]The methanol which H_2 generating takes is a 0.15 l/min (steam) grade to a 50-km/h run.
[0038]As mentioned above, since the 1st example reforms a little fuel in the H_2 generator 11 and performs H_2-NO_X reduction using the low temperature side characteristic of the reduction catalyst 12, It is a practically significant lean burn NO_X reduction system which can measure reduction of NO_X regardless of the operation excess air factor lambda of engine E_1. CO which carries out a byproduction with H_2 is a water gas shift reaction. [0039]
[Formula 5]

$$CO + H_2O \rightarrow H_2 + CO_2$$

[0040]It comes out, and changes into H_2, or Pd film separates into H_2 and CO, and there is also the method of supplying ahead of the reduction catalyst 12 as high grade H_2. However, CO which carries out a byproduction is little, can be committed in the reduction catalyst 12 as a reducing agent as it is, and does not emit CO.
[0041]
[The 2nd example] The 2nd example is a case of the gas engine used for the object for air conditioning, and power generation. Fuel shows the case of natural gas. Unlike the object for cars, the engine for stationing of such a purpose is operated by the number of certain rotations, and fixed load. Therefore, it is easy to keep the temperature of a reforming catalyst converter constant. Since the composition of the 2nd example is almost the same as that of said 1st example as shown in drawing 9, identical parts attach the same agreement and omit explanation.
[0042]Air and natural gas control the fuel supplied to a hydrogen generator by a regulating valve in order to secure required H_2 which is natural gas, is mixed with air and supplied unlike the 1st example. Control is the same as that of said 1st example almost, and does so the almost same operation effect as said 1st example.
[0043]
[The 3rd example] NO_X reduction device of the engine which combines the device and zeolitic catalyst which reform some fuel and generate H_2 in said each example, and carries out reduction purifying of the NO_X, It has turned out that a big difference is produced for NO_X reduction performance according to the conditions of supply of H_2, and the contents. As shown in drawing 10, exhaust air of the engine containing NO_X and O_2 is passed for a catalyst, and NO_X purifying rate at the time of supplying H_2 from the upper stream of a reforming catalyst converter is shown in drawing 11. In drawing 11, a horizontal axis shows the supply rate of H_2 to NO_X, and 1.0 is a case where NO_X and H_2 are the equivalents. A vertical axis is the rate that NO_X is purified by reduction, and 1.0 shows that all NO_X will be purified.

[0044]When the catalyst 61 of the pellet type shown in drawing 12 is contained in the reforming catalyst converter 60 shown in drawing 10, a high purifying rate is shown that drawing 14 shows. If the catalyst 62 of the monolith type shown in drawing 13 is used, even if it is the same H_2 amount of supply, a purifying rate will fall.

[0045]H_2 and exhaust gas do not mix enough the catalyst 61 of the pellet type shown in drawing 12 at the entrance, but even if H_2 has concentration distribution, the crevice between pellets like a maze is enough mixed in the process in which gas is in direct communication and goes, and H_2 and exhaust gas are equalized.

[0046]On the other hand, many section "swage block"-like **** have the catalyst 62 of the monolith type shown in drawing 13.

Since the hole of a piece is in the direction of a gas flow independently, if H_2 has distribution at the entrance, it will be hard to mix the gas in the channel which adjoins each other mutually on the way.

According to the actual experiment, it was difficult to make thickness of an exhaust pipe thick substantially from the restrictions on mount, the gas flow rate was quick, H_2 made the high concentration region near the center section, and H_2 has produced the inconvenience hardly supplied in the monolith periphery.

Therefore, the capacity factor of a monolith type of H_2 is low compared with a pellet type.

[0047]On the other hand, when it sees as an engine exhaust gas system, a pellet's rubbing mutually and it being easy to carry out disintegration by vibration and the direct cross-section area of gas of a pellet type are small, pass resistance is large, and causes exhaust-gas-pressure increase, and there is a fault which gets worse in the engine performance itself. Therefore, although it is desirable to use a monolith type for a catalyst, a device is needed for supply of H_2 in this case.

[0048]Then, the 3rd example comprises the constitutionally simple device which mixes supply of H_2 homogenously so that NO_X purifying rate which was superior to the pellet type using the catalyst of a monolith type may be acquired. That is, the essential structure of the H_2 jet nozzle 63 as the mixed device 69 is shown in drawing 14 and drawing 15. The inserted H_2 jet nozzle 63 is hollow cylinder shape, and it has turned at it in the shape of an L character to the flow direction of exhaust air.

It has two or more jet holes 64 radiately.

4-6 pieces are suitable for the radiate jet hole 64 -- one row -- or two or more rows are provided. (Three rows of jet holes are allocated in drawing 14).

[0049]D is required for d not less than 20%, and since resistance of a channel will become large if d is enlarged, the insertion tube outer diameter d of the jet nozzle 63 and the inside diameter D of the exhaust pipe 65 carry out section expansion formation of some exhaust pipes 65, as shown in drawing 16. Even if the distance L from the jet nozzle 63 to the reforming catalyst converter 60 needs more than the twice [at least] of D and enlarges them 10 or more times, there are few improvement effects. The mixed device can show drawing 17 and drawing 18 composition other than ****. that is, the portion which makes H_2 stir comprises the H_2 jet nozzle 66 of a byway, and the cylinder like object with base 68 which established two

or more jet holes 67 in the wall by the major diameter from this -- about two-fold are constituted tubular. H_2 which blew off is first mixed with the exhaust air which flows into the H_2 jet nozzle 66 with the dynamic pressure of exhaust gas pressure, blows off from the container liner of the cylinder like object with base 68 in an outer case, and is further mixed by the exhaust air which flows between inside-and-outside pipes. Thus, since it passes through two steps of mixing processes, about H_2 and exhaust air can mix homogenously thoroughly.

[0050]The size (a diameter or a cross-section area) of an inside-and-outside pipe influences mixing greatly, and if a container liner is small, almost all exhaust air flows through an outer case, and cannot use dynamic pressure enough. In drawing 17 and drawing 18, as for D/d (an outer case/container liner), three to about 1.7 are effective, and the two neighborhoods of the diameter ratio of an inside-and-outside pipe are best.

[0051]Mixing becomes good, and even if the 3rd example that consists of the above-mentioned composition is a monolith type, it can acquire the same purifying rate as a pellet type. Since the amount of supply H_2 can be saved 30 to 60% in the same purifying rate, fuel which H_2 generating takes can be lessened and an engine output and the influence on fuel consumption can be reduced.

[0052]For example, if the usual operation area representative point estimates in a 1.6-l. lean burn gasoline engine, H_2 flow taken to purify 2000 rpm of engine speed value and torque 40Nm, NO_X burst size 0.44 l/min at this time, and this NO_X by H_2 reduction is 0.66 l/min. The fuel for H_2 generator becomes fuel vapor of 0.33 l/min generating H_2 of 0.66 l/min (in the case of methanol).

[0053]If drawing 17 which is D/d=2, and the device shown in drawing 18 perform mixed promotion, the amount of supply of H_2 can be managed with about 0.44 l/min of NO_X and equivalent weight, and fuel will fall to the steam of steamy 0.22 l/min of 0.22 l/min. That is, it becomes saving of 0.11 l/min.

[0054]

[The 4th example] In said example, hydrogen is generated with a hydrogen generator using a zeolitic catalyst, and if H_2 is supplied to the entrance of a zeolitic catalyst and NO_X reduction by H_2 is performed, even if high-concentration O_2 exists during exhaust air, big NO_X purifying rate is acquired.

[0055]However, compared with the conventional NO_X catalyst, for example, a three way component catalyst, and Cu-zeolitic catalyst, it is a low-temperature reaction, Compared with the conventional catalyst using the space velocity (ratio of passing gas flow l/hr to the catalyst body product l) 50,000-100,000, SV (for example, 10,000-60,000) small from the relation of reaction velocity must be used. When mounting this system, the reforming catalyst converter of this system consists of inlet gas temperature, the lower stream, for example, near an exhaust air muffler, an exhaust system. However, it is a place in which the large (the size of a converter is large) reforming catalyst converter of car structure top space velocity is installed in a car, and is hard to apply to all the cars.

[0056]Since the 4th example makes installation of a reforming catalyst converter easy, even if it makes a catalyst build in the muffler structure and the muffler for making a Lean NO_X catalyst build in a muffler, and measuring miniaturization, it enables NO_X purification from temperature conditions.

[0057]That is, since the composition of the 4th example can be managed with one of the two, without

arranging NO_X converter and an exhaust air muffler in series if the Lean NO_X catalyst 82 is made to build in the exhaust air muffler 80 as shown in drawing 20 and drawing 21, it becomes very [in disposition space] advantageous. The reforming catalyst converter 83 which gave the sound deadening effect which built the monolithic catalyst 82 (Pt-zeolite system) in the exhaust air muffler 80 is shown in drawing 20 and drawing 21.

[0058]While the exhaust air by which mixing mixing was carried out in H_2 flows from an arrow direction, it collides with the mixing plate 84, it passes through the circulating hole 85 of size plurality of this mixing plate 84 and exhaust air and H_2 are enough mixed from the upper stream of the reforming catalyst converter 83, it flows into the monolithic catalyst 82. Since the circulating hole 85 is not established in the central part which becomes the exhaust flow rate maximum on the mixing plate 84, H_2 does not concentrate on the monolith central part. the circulating hole 85 of the mixing plate 84 -- each size -- it differs in a diameter, and since multiple arrays are carried out, passing flow velocities differ, stirring of gas takes place, and a sound deadening effect is done so by interference.

[0059]By the way, as for an exhaust air muffler, it is common to be arranged in engine-exhaust-systems Osamu's tail end, and since it is cooled on the way, the inlet gas temperature of an exhaust air muffler becomes low. It is 150-200 ** also in the time of the maximum-engine-speed maximum horsepower of an engine with the highest inlet temperature, and is about 100-150 ** in an operating condition with high normal use frequency.

[0060]Since sufficient reaction is not expectable unless it is not less than 300-400 **, a catalyst cannot be made to build in in a muffler with the conventional three way component catalyst or the Lean NO_X catalyst of a Cu-zeolite system. In said example, when performing reduction by H_2, it was shown that it can purify at low temperature, but temperature is about 150-300 **, and if compared with the inlet temperature of an exhaust air muffler, it is in a little high temperature requirement.

[0061]This invention persons examined [various] experimentally what should be selected as a catalyst component about the activity of NO_X reduction catalyst which supplies H_2 under O_2 coexistence. As a result, Pd and Rh did not have activity, activity of Cu was bad, and Pt found out that high activity was shown. However, Pt needs to be high distribution and carriers which have high specific surface area (more than at least 100-m^2/g) for that purpose, such as alumina, silica, and zeolite, are required for it.

[0062]this invention persons considered pretreatment which should be performed before the Lean NO_X catalyst of NO_X reduction, and H_2 mixing by boiling many things. The result is shown in drawing 19. When H_2 is mixed to engine exhaust air and it leads to the Lean NO_X catalyst (Pt system) of NO_X reduction, as shown in the curve B, the peak of activity is near 250 ** among drawing 19.

[0063]An afterburner, a reactor, a three way component catalyst, an oxidation catalyst, etc. are established near an engine manifold, When H_2 was supplied and it led to the reforming catalyst converter of NO_X reduction after oxidizing and carrying out reduction removal of CO and the HC beforehand, as shown in the curve A in drawing 19, active temperature shifted to the low temperature side, and it newly found out that high activity was shown at 100-150 **.

[0064]In accordance with the inlet temperature of an exhaust air muffler, this temperature was closed, if

possible [for the first time] by building in the reduction catalyst 80 of a Pt-zeolite system in the exhaust air muffler 80. After removing HC and CO, the direction which performed NO_X purification by a Lean NO_X catalyst can also improve a purifying rate, and does so the practically outstanding operation effect which does not form soot on a catalyst from the imperfect reaction of HC-O_2.

[0065]The sound deadening effect is made more into fitness by installing interference tube Ex1 after the monolithic catalyst 82. Drawing 22 does so the same operation effect as drawing 20 and drawing 21, and differs in the gestalt of a mixer part with said mixing plate, and the points used as the mixing pipe 86 which is a hollow cylindrical member differ. Since the reforming catalyst converter 83 and the exhaust air muffler 80 can consider the 4th example that consists of the above-mentioned composition as unification composition, it does so the practical effect that it becomes compact and mount nature becomes good, and it does so the outstanding effect which can maintain high NO_X purifying rate in the whole drive range.

[Translation done.]

TECHNICAL FIELD

[Industrial Application]In what is called the lean burn engine and the diesel power plant, other hydrogen fueled engines, etc. which this invention requires for the nitrogen-oxides reduction device of an internal-combustion engine, and use a lean mixture and aim at the improvement in fuel consumption especially, without it spoils the goodness of the fuel consumption of the engine concerned -- the concentration of the oxygen gas (O_2 is called below) under exhaust air -- it is related with the Lean NO_X catalyst exhaust gas cleaning system which can carry out reduction purifying of the nitrogen oxides (NO_X is called below) effectively regardless of how.

[Translation done.]

* NOTICES *

PRIOR ART

[Description of the Prior Art]In a piston engine, as an internal-combustion engine and the Lord, to the reducing method of the nitrogen oxides (NO_X is called below) of exhaust air. The NO_X decreasing method by the use ** Lean NO_X catalyst of the NO_X decreasing method ** super-rarefaction air-fuel ratio by the former and ** three way component catalyst (for example, JP,1-139145,A)
Three ** are considered. However, the weight ratio of the fuel in which the method of ** is supplied to an engine, and air must be about 14.5, i.e., theoretical air fuel ratio. If fuel uses a thin air-fuel ratio from theoretical air fuel ratio, NO_X does not decrease. However, it is known that considering the economical efficiency of fuel consumption specific fuel consumption has few directions which operated the engine by the thin side from theoretical air fuel ratio as shown in drawing 2, and it is efficient.
[0003]Next, ** tends to reconcile NO_X reduction and fuel consumption reduction with what is called a lean burn engine. However, if it tries to use the air-fuel ratio which can reduce NO_X enough, it approaches the misfire limit of combustion, and engine fuel consumption not only worsens, but it will be ruined and drivability will worsen. In order to prevent this, disorder and the increase in the rate of flow are measured with the air flow in a cylinder, the rate of combustion is made quick and there are some which are going to improve a misfire limit so that it may become a thin region more. However, since the flame kernel formation at the time of ignition and the flame propagation in early stages of combustion will be barred on the contrary if air disorder and the increase in the rate of flow are performed too much, there is a limit in expansion of the misfire limit by this method. Although there is also the method of making it into the rich mixture which adjusted the air-fuel ratio distribution in a cylinder and to which only the neighborhood of an ignition plug was suitable for ignition, since the decreasing rate will decrease as the dashed line also showed generating NO_X if a misfire limit spreads to a thin side more as shown in drawing 3, a big effect is not expectable.
[0004]** In order to compensate the fault of the above-mentioned **, it is going to operate using near [slightly near theoretical air fuel ratio] a specific-fuel-consumption minimum score from a misfire limit, and NO_X in which reduction is a little insufficient tends to purify with a zeolite system Lean NO_X catalyst. This method may become a fuel-efficient system. However, there is a problem which should be solved practically that NO_X purifying rate and endurance of catalyst this Lean NO_X catalyst will return NO_X under a lot of O_2 existence during exhaust air, severe [a catalyst] temperature conditions etc. and sufficient under the

present circumstances can be easily incompatible. The method of reducing NO_X enough all has many practical problems, using the air-fuel ratio which can make engine specific fuel consumption small as much as possible as mentioned above.

[0005]By the way, although it is fundamentally the same that excess O_2 is included during exhaust air also by the lean burn engine or a diesel power plant, O_2 concentration becomes large, so that exhaust air of this engine uses a lean mixture including O_2 during exhaust air. The catalyst which performs NO_X reduction purifying under exhaust air containing such O_2 is called Lean NO_X catalyst, and the catalyst of a precious-metals system, for example, a zeolite system, is used in many cases. In this Lean NO_X catalyst, the relation between NO_X purifying rate and temperature shows drawing 4. And a not less than 350 ** pyrosphere is mainly a reaction of HC-NO_X. A low temperature region 250-350 ** or less serves as a reduction reaction by H_2 of NO_X, and purification of NO_X is possible for it.

[0006]However, since an exhaust-gas temperature amounts also to a maximum of 800-900 ** since a Lean NO_X catalyst is installed near an engine exhaust manifold, and an air-fuel ratio uses a thin side from theoretical air fuel ratio in exhaust air of a lean burn engine, H_2 hardly exists during exhaust air. Therefore, the characteristic by the side of low temperature was a field which cannot be used conventionally.

[Translation done.]

EFFECT OF THE INVENTION

[Function and Effect]NO_X reduction device of the internal-combustion engine of this invention which consists of the above-mentioned composition does the following operations so.

[0010]Namely, NO_X reduction device of the internal-combustion engine of this invention which this invention person etc. invented, The basis of the existence of NO_X and O_2 during exhaust air according to combustion of supply fuel in the combustion chamber of an internal-combustion engine by having composition as shown in drawing 1, Carry out the catalytic reaction of H_2 and the NO_X, and to the entrance side of nitrogen gas and the catalyst device formed in the exhaust system decomposed into water Methanol or LPG, H_2 from the hydrogen generator which leads some hydrocarbon fuel, such as natural gas, to a reforming catalyst converter, and generates H_2 is supplied, The operation effect which carries out direct reduction purification of the NO_X under said exhaust air exactly efficiently by this H_2 under the exhaust air low temperature atmosphere in near the silencer of an exhaust system, and reduces this NO_X is done so. For this reason, NO_X reduction device of the internal-combustion engine of this invention, Since an engine operating air-fuel ratio can reduce NO_X according to a catalyst regardless of the concentration of existence of O_2 a thin side and under exhaust air, or O_2 from a rich side, theoretical air fuel ratio, and theoretical air fuel ratio, from theoretical air fuel ratio On engine (car) performance, The profitableness which can choose an optimum value without taking into consideration fuel consumption top NO_X reduction conditions can be given.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]The purpose of this invention is what solves the above-mentioned conventional various problems, Without spoiling the goodness of the fuel consumption of a lean burn engine or a diesel power plant under coexistence of NO_X and O_2 during exhaust air of a lean burn engine or the diesel power plant always operated by the $Oover_2$ (air) side, the concentration of O_2 under exhaust air -- it is going to provide NO_X reduction device of the exhaust gas cleaning system, i.e., the internal-combustion engine which can control the burst size of NO_X, which carries out reduction purifying of the NO_X effectively regardless of how.

[Translation done.]

MEANS

[Means for Solving the Problem]NO_X reduction device of an internal-combustion engine of this invention, A basis of existence of NO_X and O_2 during exhaust air by combustion of fuel supplied from a fuel supply system in a combustion chamber of an internal-combustion engine, Form a catalyst device for carrying out catalytic reaction of H_2 and the NO_X within an exhaust system, and purifying NO_X, and. Provide a hydrogen generator which generates hydrogen by a reforming catalyst converter for some hydrocarbon fuel, such as methanol or LPG, and natural gas, in an entrance side of this catalyst device, and H_2 is constituted so that supply is possible, It is the composition of carrying out direct reduction purification of the NO_X under said exhaust air by H_2 from this hydrogen generator under an exhaust air low temperature atmosphere in near the silencer of an exhaust system, and having reduced this NO_X.

[Translation done.]

EXAMPLE

[Example]A reforming catalyst converter is classified according to the fuel which uses the hydrogen generator in an example for an engine as follows.
[0012]That is, if it is in the engine which uses methanol as fuel, the gas which carried out heating evaporation of the methanol by exhaust air is led to this catalyst using transition metal catalysts, such as 1Pd, Pt, and Cu/Cr/nickel, and H_2 is generated. About 300 ** is best and catalyst inlet gas temperature is a reaction at this time. [0013]
[Formula 1]
$$CH_3OH \rightarrow CO + 2H_2$$

[0014]It becomes.
[0015]2) Make methanol vapour mix air, according to Cu-nickel-Cr/alumina catalyst, carry out partial oxidation of some methanol, and generate H_2. 400 ** - 500 ** are suitable for temperature, it controls the air flow rate made to mix in methanol, and maintains temperature. The reaction in this case, [0016]
[Formula 2]
$$CH_3OH + Air \rightarrow H_2 + CO + H_2O$$

[0017]It becomes.
[0018]3) Cu-Mn or Cu-Zn is used for a catalyst, and add a steam to methanol, or add air and methanol water, and perform steam reforming. About 250 ** is suitable and temperature is a reaction. [0019]
[Formula 3]
$$CH_3OH + H_2O \rightarrow 3H_2 + CO_2$$

[0020]It becomes.
[0021]If it is in the engine using hydrocarbon fuel, such as LPG and natural gas, nickel, CO, and Rh are used as a catalyst and it reforms at the temperature of 300-800 **. In the case of this hydrocarbon fuel, the water from a steam, air, or a water tank is added, and refining is carried out to it. (Temperature changes with catalysts.) There is much methane at low temperature and there is much CO at an elevated temperature. As a reaction, [0022]
[Formula 4]

$HC + H_2O \rightarrow H_2 + CH_4 + CO_2$ 300～500℃

$HC + H_2O \rightarrow H_2 + CO + CO_2$ 800℃

$HC + Air \rightarrow H_2 + CO$ 800℃

$HC +$ 排気 $\rightarrow H_2 + CO$ 700℃

（ＥＧＲ改質）

[0023]It becomes.

[0024]NO_X reduction device of the internal-combustion engine of this example, NO_X flow is computed from the output of the NO_X sensor 6 with which the exhaust pipe of said exhaust system is equipped, and the suction-air-quantity sensor 5, It can also have composition which controls the air content and the amount of reforming fuel in the case of performing the engine exhaust gas flow or partial oxidation which determines the always proper amount of H_2 and heats the reforming catalyst converter as said hydrogen generator.

[0025]NO_X reduction device of the internal-combustion engine of this example, The number of rotations of the internal-combustion engine concerned, intake pipe negative pressure, As an intake throttle valve opening or a fuel supply system. It can also have composition made into the learning control method which controls the fuel quantity which possesses the sensor which can detect the operating condition in internal-combustion engines, such as injection quantity of ************, carries out prediction arithmetic of the NO_X flow from the output of the sensor concerned, and is supplied to the reforming catalyst converter of said hydrogen generator.

[0026]And since NO_X reduction device of the internal-combustion engine of this example makes mixing of H_2 and exhaust air uniform in the entrance side of said catalyst device, it can possess a mixer or can also consider it as the composition which uses the silencer of an exhaust system effectively.

[0027]If it explains in full detail, NO_X reduction device of the internal-combustion engine of this example was invented in order to solve said conventional problem, and shows drawing 1 the basic constitution figure. That is, the 1st point of this example is that this H_2 reduction uses it in the whole drive range of the engine E by the exhaust air low temperature side. The 2nd point is incorporating the H_2 generator 1 into a constitution system in order to enable use by the side of low temperature. The 3rd point is controlling the H_2 generator 1 by the operational status of the engine E, or the amount of NO_X under exhaust air, and enabling it to always supply an equivalent grade or superfluous H_2 by NO_X and a mol during exhaust air.

[0028]Since H_2 will react to O_2 and the selectivity of H_2-NO_X will be lost if exposed to an elevated temperature, the reduction catalyst 2 is arranged near the silencer 3 so that it may not be exposed to not less than 350 **. And this example branches from fuel piping, carries out introductory reforming of the fuel via a flow control valve at the reforming catalyst converter as an H_2 generator, and generates H_2. H_2 is supplied near the entrance of the reduction catalyst 2. In order to make H_2 to supply into an equivalent grade by NO_X and the mol under exhaust air, an air content is measured by the suction-air-quantity sensor 5

of the engine E, boil NO_X concentration under exhaust air NO_X sensor 6, after asking for **** and calculating NO_X flow from the output of both the sensors 5 and 6 by the controller 7, It is the composition which controls the air valve for refining by the fuel flow introduced into a reforming catalyst converter in order to generate H_2 corresponding to NO_X flow, and the thing which performs reforming catalyst converter temperature by an exhaust air flow dividing valve, and partial oxidation.

[0029]In drawing 5, the delivery late of H_2 [as opposed to NO_X in a horizontal axis] and a vertical axis show the reduction rate (purifying rate) of NO_X. If equivalent weight of H(mol) $_2$ is supplied to NO_X, and NO_X and H_2 shall be mixed thoroughly, reduction purifying of all the NO_X will be carried out (theoretical value). However, since complete mixing is not carried out actually, a reduction rate becomes like an experimental value. Although there is a portion to which the purifying rate is good from theory in the experimental value, it is because the steam under exhaust air decomposed on the precious-metals system catalyst and has changed this into H_2. Therefore, many H_2 reacts to NO_X from supplied H_2.

[0030]In NO_X reduction device which performs reduction purifying by H_2 as other examples, it can be considered as the function to install the mixer which carries out mixed mixing of H_2 and exhaust air in the entrance side of a reforming catalyst converter. The hydrogen generator and catalyst device which are NO_X purges of others of this example, Since it has a respectively suitable operating temperature range, a reduction catalyst can be installed in the inside of the muffler to which exhaust air expands and temperature falls at 200 ** or less, or its lower stream again in the latter part of the oxidation catalyst which installed the hydrogen generator in the exit of an exhaust manifold in the exhaust system of an internal-combustion engine.

[0031]In NO_X reduction device which supplies H_2 of a hydrogen generator and carries out reduction purifying of the NO_X under engine exhaust gas under O_2 coexistence as other examples, It can have composition which has a means to oxidize HC, such as an oxidation catalyst, a three way component catalyst, and an exhaust air reactor, and CO near an engine exhaust manifold, and uses Pt-zeolitic catalyst for the reforming catalyst converter as a Lean NO_X catalyst. A sound deadening effect can be given to a reforming catalyst converter, and a reforming catalyst converter and an exhaust air muffler can be considered as unification composition.

[0032]And in NO_X purge which performs NO_X reduction by H_2, it can have composition which installed the soot trapper and the unburnt glow output oxidizing means upstream of the reforming catalyst converter as an object for diesel engines. In this example, a hydrogen fueled engine besides a gasoline engine and a diesel power plant may be sufficient as an internal-combustion engine, and it can be applied effective in these NO_X reduction devices. In the case of this hydrogen fueled engine, a hydrogen generator is not required, and it can be applied by supplying H_2 as fuel in bypass via a controller.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The lineblock diagram showing the basic constitution of the example of this invention

[Drawing 2]The diagram showing an air-fuel ratio and the relation of a fuel economy

[Drawing 3]The diagram showing the fuel consumption of a lean burn engine, and the relation of NO_X

[Drawing 4]The diagram showing the characteristic of a Lean NO_X catalyst

[Drawing 5]The diagram showing the relation between H_2 supply rate and NO_X purifying rate

[Drawing 6]The lineblock diagram showing the outline of the 1st example device of this invention

[Drawing 7]The sectional view of H_2 generator in the 1st example device

[Drawing 8]The lineblock diagram expanding and showing the important section of H_2 generator of others in the 1st example device

[Drawing 9]The lineblock diagram showing the outline of the 2nd example device of this invention

[Drawing 10]The lineblock diagram showing the outline of the 3rd example device of this invention

[Drawing 11]The diagram showing the relation of NO_X purifying rate about the 3rd example device

[Drawing 12]The schematic diagram showing pellet type catalyst composition about the 3rd example device

[Drawing 13]The schematic diagram showing the catalyst composition of a monolith type about the 3rd example device

[Drawing 14]Drawing of longitudinal section showing the outline of the 3rd example device of this invention

[Drawing 15]The cross-sectional view showing the outline of the 3rd example device of this invention

[Drawing 16]The schematic diagram showing the outline of the 3rd example device of this invention

[Drawing 17]Drawing of longitudinal section showing the example of others of the 3rd example device of this invention

[Drawing 18]The cross-sectional view showing the example of others of the 3rd example device of this invention

[Drawing 19]The diagram showing NO_X purifying rate situation about the 4th example of this invention

[Drawing 20]Drawing of longitudinal section showing the outline of the 4th example device of this invention

[Drawing 21]The cross-sectional view showing the outline of the 4th example device of this invention

[Drawing 22]Drawing of longitudinal section showing the composition of others of the 4th example device of this invention

[Description of Notations]

E, E_1 engine

1 and 11 H_2 generator

3, 13, and 80 Silencer

12 and 60 Reduction catalyst

9 Oxidation catalyst

5 Suction-air-quantity sensor

6 NO_X sensor

7 Control power supply

10 Mixer

[Translation done.]

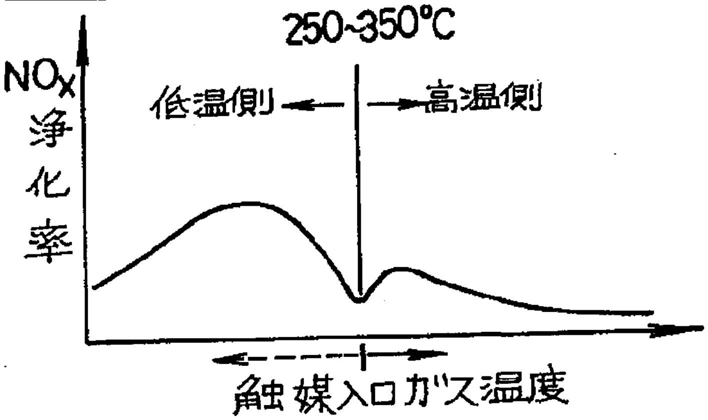
* NOTICES *

JPO and INPIT are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 4]



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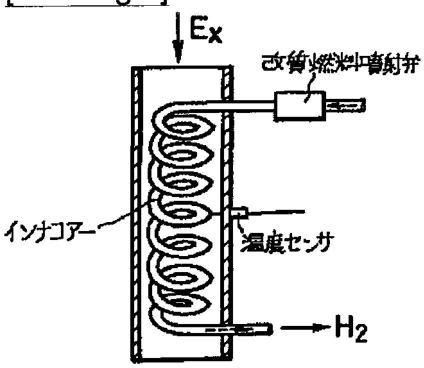
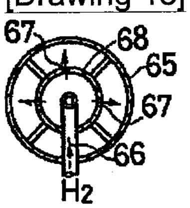


[Drawing 18]



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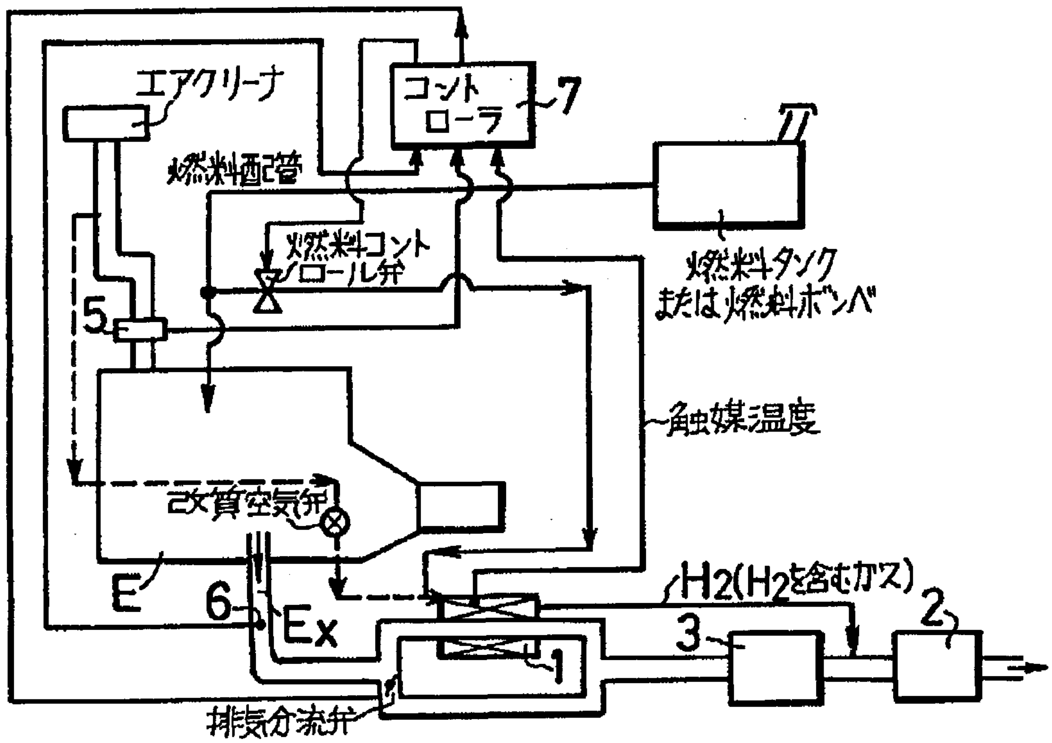

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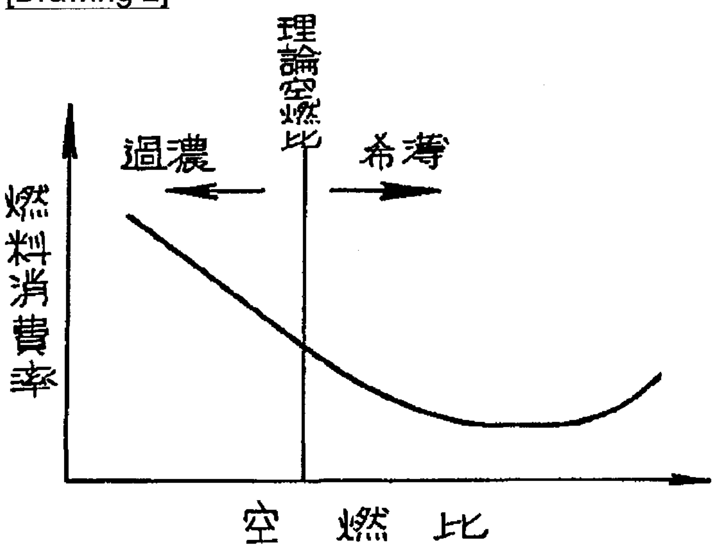

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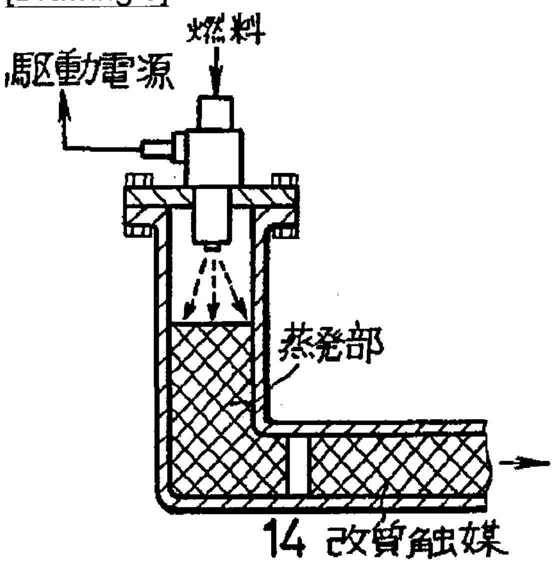

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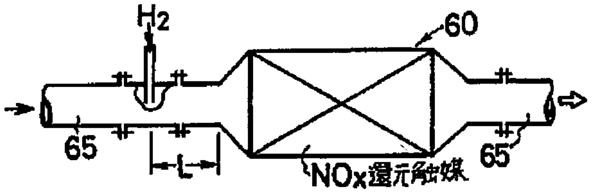

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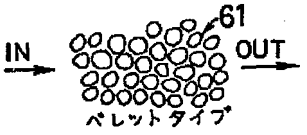

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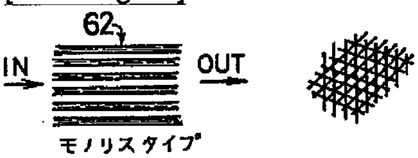

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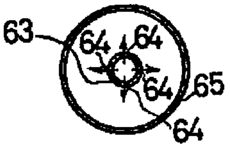

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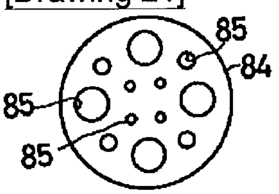

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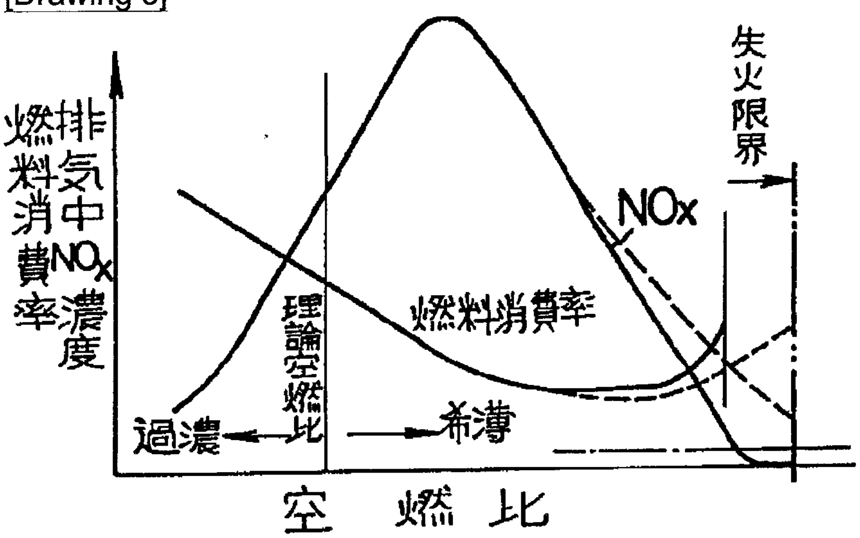

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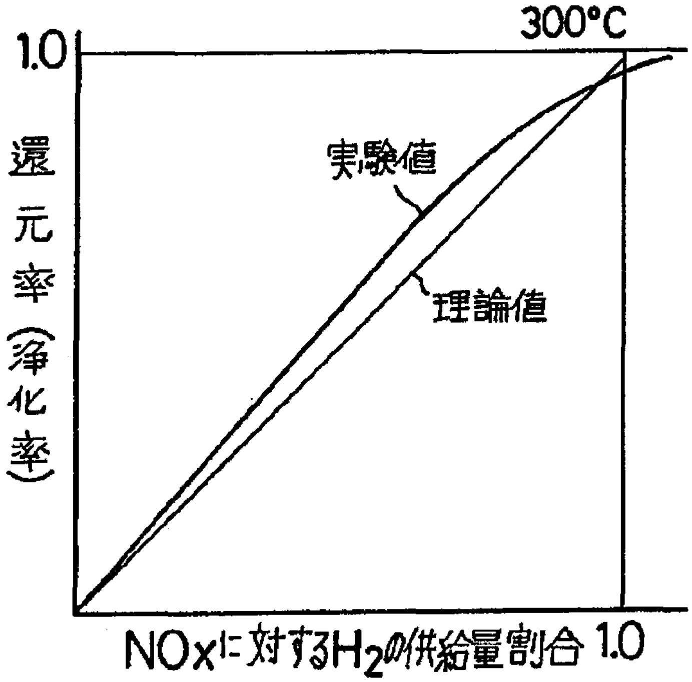

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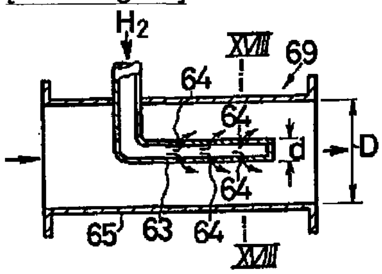

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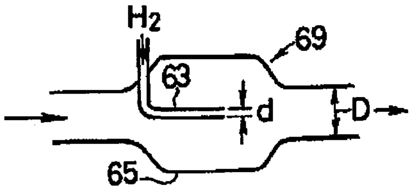

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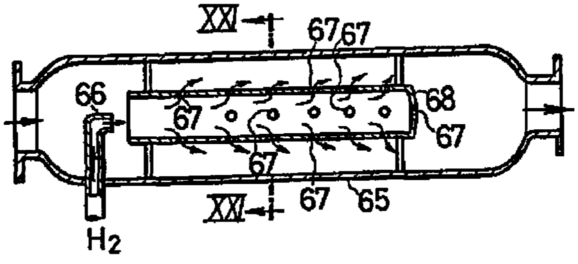

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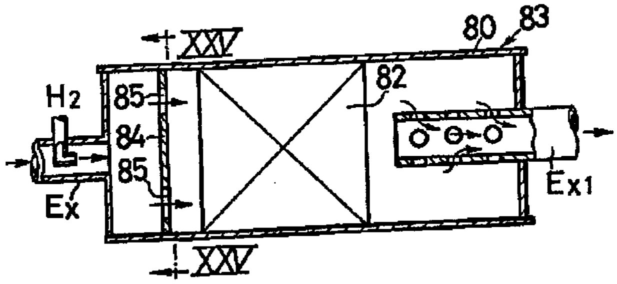

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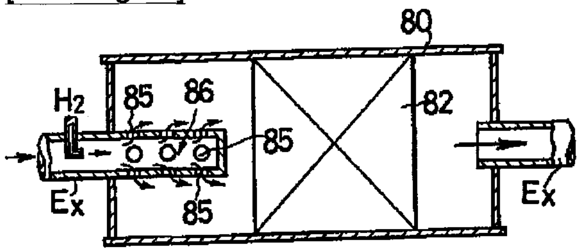

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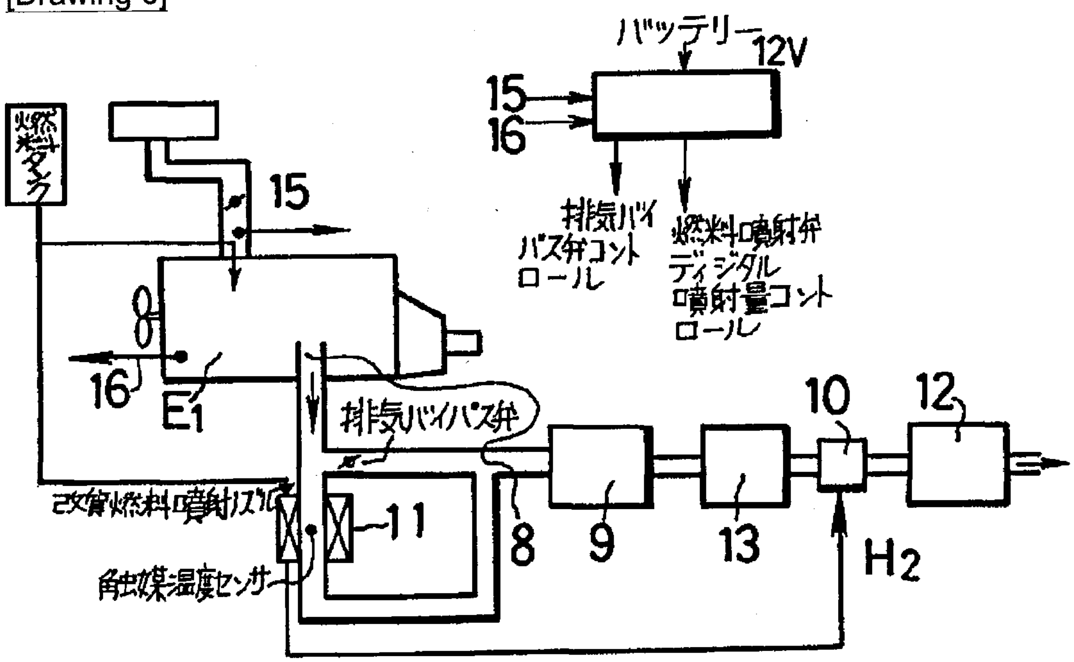

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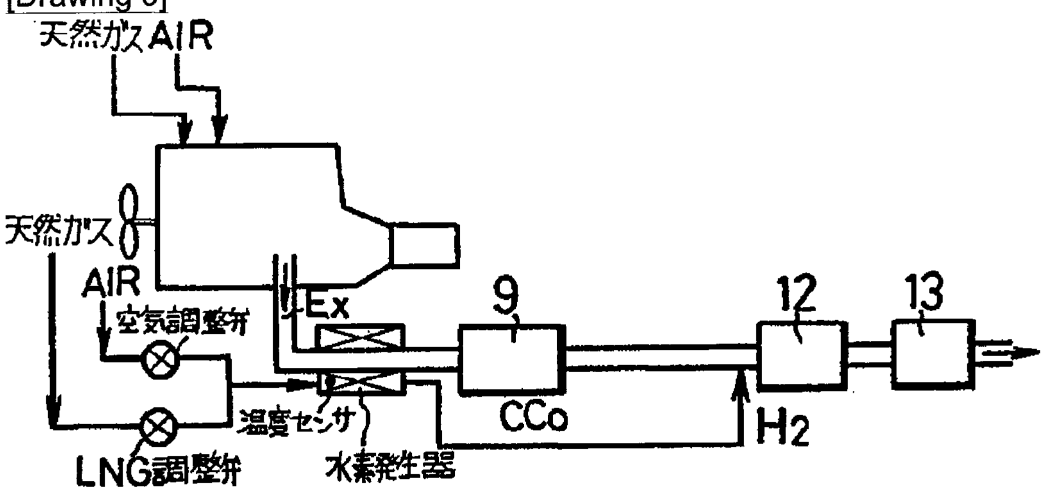

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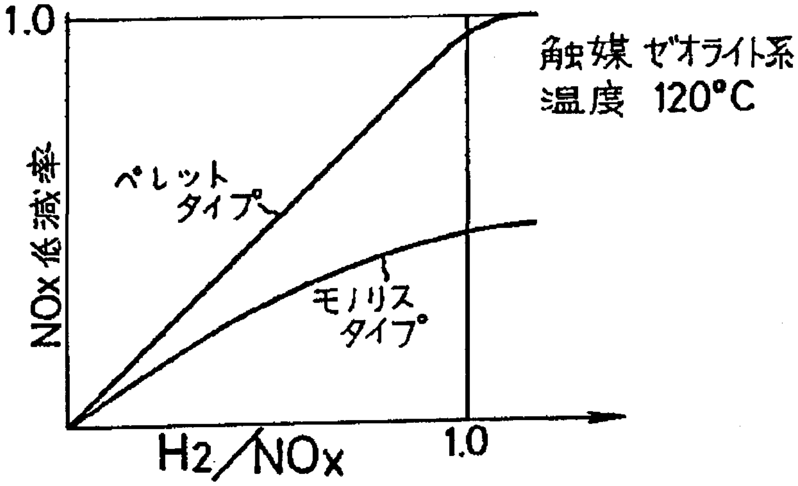

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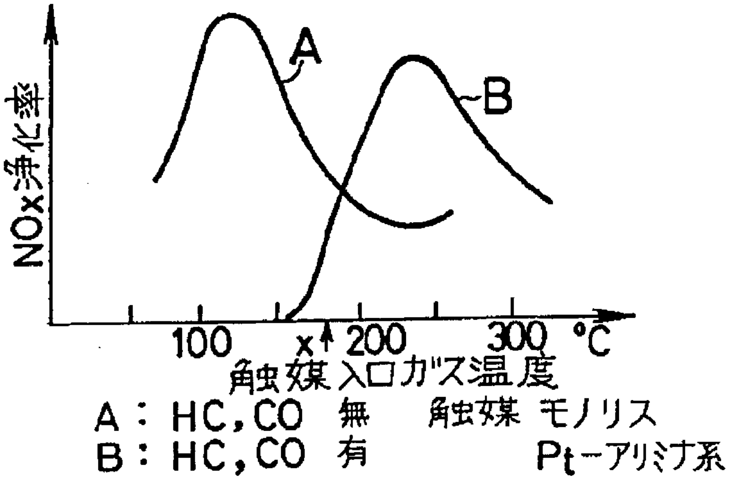

[Translation done.]